TREATISE

ON

THE NATURAL HISTORY AND DISEASES

OF THE

HUMAN TEETH:

EXPLAINING THEIR STRUCTURE, USE, FORMATION, GROWTH, AND DISEASES.

IN TWO PARTS.

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With Notes

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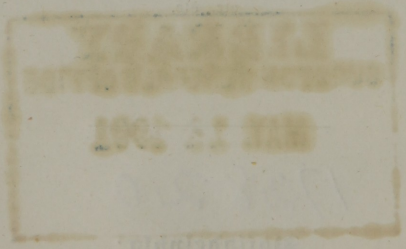

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PREFACE.

The state of Dental Surgery at the period when Hunter wrote the following work was perhaps lower than that of any department of professional science or practice. The treatment of the teeth was still consigned to the hands of the ignorant mechanic, whose knowledge was limited to the forcible extraction of aching teeth, the manufacture of substitutes for those which were lost, and some rude methods of filling the cavities produced by decay. That this state of a branch of practice, as susceptible of a connexion with physiological and pathological science, and as improveable by such a connexion as any other, should have early attracted the attention of a man preëminently qualified for detecting and supplying such deficiencies, and whose labours, unparalleled as they are for their scientific importance, are not less valuable from the immense influence they have since exerted upon the practice both of medicine and surgery, might have been anticipated, from the peculiar character of his mind, which was too truly great to think any subject unworthy of his anxious attention which involved the improvement of the art of healing, or the extension of our knowledge of Nature's operations. If it may be stated that the work in question is perhaps the least felicitous effort of this extraordinary genius, and that of which the errors are the most obvious and striking, some apology may be found even for these, in the confined nature of the subject, and especially in the obscure and anomalous structure of the organs of which it treats; whilst the basis which his experiments and observations have laid for subsequent improvements in our knowledge, both of the physiology and pathology of the teeth, as well as in the treatment of their diseases, constitutes a never-ceasing claim to the gratitude and admiration of every scientific practitioner of dental surgery. If, therefore, it may with truth be said that he was the father of scientific surgery; if he may claim the high distinction of having placed the practice of surgery upon the only solid foundation, that of physiological science, it is no less true of this humble

department than of those more important branches of the art, in which are involved the knowledge and treatment of diseases which stand in immediate connexion with vital organs and functions.

It is not uninteresting, even in this work, to trace the peculiarities of his genius, and to watch the workings of his mind in his search after truth, which he pursued with an ingenuousness and candour which have never been surpassed, and rarely, if ever, equalled. It is, indeed, amongst the remarkable characteristics of his reasonings and conclusions,—and this must be the case, too, with all who follow truth with equal zeal and singleness of purpose,—that even his errors arise from that inviolable love of truth, that single aim at establishing, not the dogmas of a favourite theory, but the simple laws of Nature herself, which constitutes one principal charm of his greatest and most important discoveries. This is shown in a very striking point of view by the error, and even inconsistency into which he falls when reasoning on the structure of the teeth. His observations and experiments had shown him that these organs differ in many important respects from the other bones: that the phenomena which these two organs present under comparative circumstances, whether of disease or of experiment, differ in many important respects; that the teeth are not susceptible of artificial injection; that they cannot restore lost parts; and many other peculiarities, which led him too hastily to infer that "they are to be considered as extraneous bodies with respect to a circulation through their substance," though the same candour obliges him to confess, in the same sentence, that "they have most certainly a living principle, by means of which they make part of the body, and are capable of uniting with any part of a living body," although the experiments on which he founds the latter proposition, if they prove anything, prove that this union with a living body is effected by means of a vascular continuity. Here, then, is an example of a love of truth for her own sake, so pure, so invulnerable, that not even to avoid the dilemma into which his imperfect reasoning upon these two inconsistent propositions must necessarily force him, will he sacrifice, or modify, or gloss over one tittle of the facts on which they are founded.

Whatever errors, however, may have crept into this work from the causes already alluded to, it forms the basis of all that has since been done to improve the knowledge of this branch of practice, and still more remarkably has it proved the foundation of all that is now known on the physiology of the teeth. It must, on the

other hand, be conceded to his immediate follower, Dr. Blake, that if he received from Hunter the hints from which his own discoveries were deduced, he has so clearly elucidated what in the former was obscure, so judiciously supplied what was deficient, and so satisfactorily harmonized what appeared to be incompatible or inconsistent, that he well deserves the praise of having contributed more to the right understanding of the subject than any other writer that has ever treated on it either before or since; and his inaugural dissertation (the work, it must be remembered, of a pupil,) contains opinions and statements on the structure, the formation, the growth, and the relations of these organs, which most subsequent writers have done well to copy, and all experimental physiologists have only been able to confirm.

The late Joseph Fox, with far less of original talent than his precursor, brought to the practice of his profession a mind well prepared for a diligent, correct, and rational discharge of its duties. If, therefore, his intellectual character were such as precluded him from distinguishing himself in the field of original investigation and discovery, the sober reflective habits of his mind, joined to a regular professional education, enabled him to obtain from an extensive practice such a knowledge of the diseases of these organs, and such well-grounded principles their treatment, as to render his work a very valuable acquisition, not to the professed dentist only, but particularly to the general practitioner; a class of the profession to which his labours were especially devoted, as he lectured on this subject for many years in the theatre of Guy's Hospital.

It is, then, to the writers just mentioned that the profession is principally indebted for the knowledge it at present possesses of the anatomy, physiology, and diseases of the teeth. It would be useless here to notice the numerous books which have from time to time appeared, chiefly derived, as they are, from these sources, the merits of which may generally be stated to be in the inverse ratio of their originality. Equally unnecessary is it to enter into an elaborate consideration of the hypotheses which are entertained on the nature of these organs by some of the most distinguished French physiologists. The object of the author in the annotations affixed to the following Treatise has been rather to avail himself of such means as lay before him, to elucidate the text where it is obscure, to correct its errors where subsequent investigations have proved errors to exist, and to add such information on subjects imperfectly treated on as the observations and experience of others, or his own,

have enabled him to obtain. He has entered upon the task with a degree of diffidence commensurate with the respect which the name of Hunter commands, and with a sacred regard to the same object of general utility as formed the guiding star to the great Original whose work he thus humbly endeavours to illustrate.

T. BELL.

New Broad Street, February 1835.

N.B. The Editor's Notes are distinguished from the Author's by being placed within brackets.

THE

NATURAL HISTORY

OF

THE HUMAN TEETH.

PART I.

Of the Upper Jaw.

Before we enter into a description of the teeth themselves, it will be necessary to give an account of the upper and lower jaw-bones, in which they are inserted; insisting minutely on those parts which are connected with the teeth, or serve for their motion and action, and passing over the others slightly.

The upper jaw is composed of two bones, which generally remain distinct through life. They are very irregular at their posterior and upper parts, sending upwards and backwards a great many processes, that are connected with the bones of the face and skull.* The lower and anterior parts of the upper jaw are more uniform, making a kind of circular sweep from side to side, the convexity of which is turned forwards; the lower part terminates in a thick edge, full of sockets for the teeth. This edge is called in each bone the alveolar process. Behind the alveolar processes there are two horizontal lamellæ, which uniting together, form part of the roof of the mouth, which is the partition between the mouth and the nose.

This plate, or partition, is situated about half an inch higher than the lower edge of the alveolar process; and this gives the roof of the mouth a considerable hollowness.

The use of the upper jaw is to form part of the parietes of the

* Pl. II. f. 1 & 2. *a*, *a*.

mouth, nose, and orbits; to give a basis, or supply the alveolar process, for the superior row of teeth, and to counteract the lower jaw; but it has no motion itself upon the bones of the head and face.

Of the Lower Jaw.

As the lower jaw is extremely moveable, and its motion is indispensably necessary in all the various operations of the teeth, it requires to be more particularly described. It is much more simple in its form than the upper, having fewer processes, and these not so irregular. Its anterior circular part is placed directly under that of the upper jaw; but its other parts extend further backwards.*

This jaw is at first composed of two distinct bones; but these, soon after birth, unite into one, at the middle of the chin. This union is called the symphysis of the jaw. Upon the upper edge of the body of the bone is placed the alveolar process, a good deal similar to that of the upper jaw. The alveolar process extends all round the upper part of the bone, from the coronoid process of one side to that of the other. In both jaws they are everywhere relatively proportioned to the teeth, being thicker behind, where the teeth are larger and more irregular, upon account of the more numerous fangs inserted into them. The teeth that are situated backwards in the upper jaw, have more fangs than those that correspond with them in the lower, and the sockets are accordingly more irregular. The alveolar process of the upper jaw is a section of a larger circle than that of the lower, especially when the teeth are in the sockets. This arises chiefly from the anterior teeth in the upper jaw being broader and flatter than those in the lower.† The posterior part of the bone on each side rises almost perpendicularly, and terminates above in two processes;‡ the anterior of which is the highest, is thin and pointed, and is called the coronoid process.§ The anterior edge of this process forms a ridge, which goes obliquely downward and forward on the jaw, upon the outside of the posterior sockets.‖ To this process the temporal muscle is attached; and as it rises above the centre of motion, that muscle acts with nearly equal advantage in all the different situations of the jaw.

The posterior process, which is made for a moveable articulation with the head, runs upward, and a little backward; is narrower, thicker, and shorter than the anterior; and terminates in an oblong rounded head, or condyle,¶ whose longest axis is nearly transverse. The condyle is bent a little forward; is rounded, or convex, from the fore to the back part; and likewise a little rounded from one end to the other, or from right to left. Its external end is turned

* Pl. I. f. 1 & 2. † Pl. I. f. 1. ‡ Pl. I. f. 2 *e* & *d*; and Pl. II. f. 2. *e* & *f*.
§ Pl. II. *e*, *e*. ‖ Pl. I. f. 2, *b*. ¶ Pl. II. f. 2. *f*.

a little forward, and its internal a little backward; so that the axes of the two condyles are neither in the same straight line, nor parallel to each other; but the axis of each condyle, if continued backwards, would meet, and form an angle of about one hundred and forty-six degrees; and lines drawn from the symphisis of the chin of the middle of the condyle would intersect their longest axis at nearly right angles.* There are, however, some exceptions, for in the lower jaw of which I have a drawing, the angle formed by the supposed continuation of the two axes, instead of being an angle of one hundred and forty-six degrees, is of one hundred and ten only. The lower jaw serves for a base to support the teeth in the alveolar process during their action on those of the upper jaw in mastication, and to give origin to some muscles that belong to other parts.

Of the Alveolar Processes.

The alveolar processes are composed of two thin bony plates, one external and the other internal. These two plates are at a greater distance from each other at their posterior ends, than at the anterior, or middle part of the jaw. They are united together by thin bony partitions going across, which divide the processes at the anterior part into just as many distinct sockets as there are teeth; but at the posterior part, where the teeth have more than one root or fang, there are distinct cells or sockets for every root. These transverse partitions are more protuberant than the alveolar plates, and thus add laterally to the depth of the cells, particularly at the anterior part of the jaw. At each partition the external plate of the alveolar process is depressed, so as to form a fluting† round the cells or cavities for the roots of the teeth. This is observable in the whole length of the alveolar process of the upper jaw, and in the fore part particularly of the lower jaw. The alveolar processes of each jaw form about one half of a circular, or rather of an elliptical, figure; and at the fore part in the lower jaw they are perpendicular, but project inwards at the posterior part, and describe a smaller circle than the body of the bone upon which they stand, as we shall observe more particularly hereafter, when we come to treat of the jaws of old people.

The alveolar processes of both jaws should rather be considered as belonging to the teeth than as parts of the jaws; for they begin to be formed with the teeth, keep pace with them in their growth, and decay and entirely disappear when the teeth fall out; so that if we had no teeth, it is likely we should not only have no sockets, but not even these processes in which the sockets are formed; for the jaws can perform their motions, and give origin to muscles, without either the teeth or alveolar processes. In short, there is such a mutual dependence of the teeth and alveolar processes on

* Pl. II. f. 2. † Pl. I. f. 2. *f, f, f, f.*

each other, that the destruction of the one seems to be always attended with that of the other.*

In the head of a young subject which I examined, I found that the two first incisor teeth in the upper jaw had not cut the gum, nor had they any root or fang, excepting so much as was necessary to fasten them to the gum, on their upper surface; and on examining the jaw, I found there was no alveolar process nor sockets in that part. What had been the cause of this I will not pretend to say; whether it was owing to the teeth forming not in the jaw but in the gum, or to the wasting of the fangs. The appearance of the tooth favoured the first supposition, for it was not like those whose fangs are decayed in young subjects, preparatory to the shedding of the teeth; and as it did not cut the gum, it is reasonable to think it never had any fang. That end from which the fang should have grown was formed into two round and smooth points, having each a small hole leading into the body of the tooth, which was pretty well formed.

Of the Articulation of the Lower Jaw.

Just under the beginning of the zygomatic process of each temporal bone, before the external meatus auditorius, an oblong cavity may be observed, in direction, length, and breadth in some measure corresponding with the condyle of the lower jaw. Before and adjoining to this cavity, there is an oblong eminence, placed in the same direction, convex upon the top, in the direction of its shorter axis, which runs from behind forwards; and a little concave in the direction of its longer axis, which runs from within outwards. It is a little broader at its outer extremity, as the outer corresponding end of the condyle describes a larger circle in its motion than the inner. The surface of the cavity and eminence is covered with one continued smooth cartilaginous crust, which is somewhat ligamentous, for by putrefaction it peels off, like a membrane, with the common periosteum. Both the cavity and eminence serve for the motion of the condyle of the lower jaw. The surface of the cavity is directed downward; that of the eminence downward and backward, in such a manner that a transverse section of both would represent the italic letter *S*. Though the eminence may, on a first view of it, appear to project considerably below the cavity, yet a line drawn from the bottom of the cavity to the most depending part of the eminence is almost horizontal, and therefore nearly parallel with the line made by the grinding surfaces of the teeth in the upper jaw: and when we consider the articulation further, we shall find that these two lines are so nearly parallel that the condyle

* [This observation is strictly correct: however rapidly the gum becomes absorbed, whether from indigestion, the use of mercury, the accumulation of calculous matter, or that affection which is vulgarly termed scurvy in the gum, the alveolar process never becomes exposed (unless it be a dead portion exfoliating), but absorption of the bone always keeps pace with that of the gum.]

moves almost directly forwards in passing from the cavity to the eminence; and the parallelism of the motion is also preserved by the shape of an intermediate cartilage.

In this joint there is a moveable cartilage, which, though common to both condyle and cavity, ought to be considered rather as an appendage of the former than of the latter, being more closely connected with it, so as to accompany it in its motion along the common surface of both the cavity and eminence. This cartilage is nearly of the same dimensions with the condyle, which it covers, and is hollowed out on its inferior surface, to receive the condyle. On its upper surface it is more unequal, being moulded to the cavity and eminence of the articulating surface of the temporal bone, though it is considerably less, and is therefore capable of being moved with the condyle, from one part of that surface to another. Its texture is ligamento-cartilagineous. This moveable cartilage is connected with both the condyle of the jaw and the articulating surface of the temporal bone, by distinct ligaments, arising from its edges all round. That by which it is attached to the temporal bone is the most free and loose; though both ligaments will allow an easy motion of the cartilage on the respective surfaces of the condyle and temporal bone. These attachments of the cartilage are strengthened, and the whole articulation secured, by an external ligament, which is common to both, and which is fixed to the temporal bone, and to the neck of the condyle. On the inner surface of the ligament which attaches the cartilage to the temporal bone, and backwards, in the cavity, is placed what is commonly called the gland of the joint; at least the ligament is there much more vascular than at any other part.

Of the Motion in the Joint of the Lower Jaw.

The lower jaw, from the manner of its articulation, is susceptible of a great many motions. The whole jaw may be brought horizontally forwards, by the condyles sliding from the cavity towards the eminences on each side. This motion is performed chiefly when the teeth of the lower jaw are brought directly under those of the upper, in order to bite or hold anything very fast between them.

Or, the condyles only may be brought forwards, while the rest of the jaw is tilted backwards, as is the case when the mouth is open; for on that occasion the angle of the jaw is tilted backwards, and the chin moves downwards, and a little backwards also. In this last motion the condyle turns its face a little forwards; and the centre of motion lies a little below the condyle, in the line between it and the angle of the jaw. By such an advancement of the condyles forwards, together with the rotation mentioned, the aperture of the mouth may be considerably enlarged; a circumstance necessary on many obvious occasions.

The condyles may also slide alternately backwards and forwards,

from the cavity to the eminence, and *vice versâ*; so that while one condyle advances, the other moves backwards, turning the body of the jaw from side to side, and thus grinding between the teeth the morsel separated from the larger mass by the motion first described. In this case the centre of motion lies exactly in the middle between the two condyles. And it is to be observed, that in these slidings of the condyles forwards and backwards, the moveable cartilages do not accompany the condyles in the whole extent of their motion, but only so far as to adapt their surfaces to the different inequalities of the temporal bone: for as these cartilages are hollow on their lower surfaces where they receive the condyle, and on their opposite upper surfaces are convex where they lie in the cavity, but anteriorly, at the root of the eminence, are a little hollowed, if they accompanied the condyles through the whole extent of their motion, the eminences would be applied to the eminences, the cavities would not be filled up, and the whole articulation would be rendered very insecure.

This account of the motion of the lower jaw and its cartilages clearly demonstrates the principal use of these cartilages, namely, the security of the articulation, the surfaces of the cartilage accommodating themselves to the different inequalities, in the various and free motions of this joint. This cartilage is also very serviceable for preventing the parts from being hurt by the friction; a circumstance necessary to be guarded against where there is so much motion. Accordingly I find this cartilage in the different tribes of carnivorous animals, where there is no eminence and cavity, nor other apparatus for grinding, and where the motion is of the true ginglymus kind only.

In the lower jaw, as in all the joints of the body, when the motion is carried to its greatest extent, in any direction, the muscles and ligaments are strained and the person made uneasy. The state, therefore, into which every joint most naturally falls, especially when we are asleep, is nearly in the middle state between the extremes of motion; by which means all the muscles and ligaments are equally relaxed. Thence it is that commonly and naturally the teeth of the two jaws are not in contact, nor are the condyles of the lower jaw so far back in the temporal cavities as they can go.

Of the Muscles of the Lower Jaw.

Having described the figure, articulation, motion, and use of the lower jaw, it will be necessary in the next place to give some account of the muscles that are the causes of its motion.

There are five pairs of muscles, each of them capable of producing various motions, according to the situation of the lower jaw, whether they act singly or in conjunction with others. Two or more of them may be so situated as to be capable of moving the jaw in the same direction; but every motion is produced by the action of more than one muscle at a time. Thus, if the jaw be depressed, and

brought to one side, either the masseter, temporal, or pterygoideus internus of the opposite side will not only raise the jaw but bring it to its middle state. It will be necessary in the description of each muscle to give its use in the different situations of the jaw, by which means, after they are all described, their compound actions will be better understood. I shall first describe those which raise the jaw; then those which give it the lateral motion; and lastly, those which depress it; proceeding in the order in which they present themselves in dissection.

The most superficial is the masseter: it is situated upon the posterior and lower part of the face, between the cheek-bone and angle of the lower jaw, directly before the lower part of the ear. It is a thick, short, complex muscle, and a little flattened: it appears to have two distinct origins, an anterior and outer, and a posterior and inner; but that is owing only to its outer edge at its origin being slit, or double, and the fibres of these two edges having a different course, decussating each other a little. The anterior and outer portion of the muscle begins to rise from a small part of the lower edge of the malar process of the maxillary bone, adjoining to the os malæ; and continues its origin all along the lower horizontal edge of this last bone to the angle where its zygomatic process turns up to join that of the temporal bone. The external layer of fibres in this portion is tendinous at its beginning, while the internal is fleshy.

The posterior and inner portion of this muscle begins to rise, partly tendinous and partly fleshy, from the same lower edge of the os malæ: not where the origin of the other portion terminates, but a little further forwards; and this origin is continued along the lower edge of the zygomatic process of the temporal bone, as far backwards as the eminence belonging to the articulation of the lower jaw.

From this extent of its origin the muscle passes downwards to its insertion into the lower jaw. The anterior external portion is broader at its insertion than at its origin; for it occupies a triangular space of the lower jaw; which, above the angle and on the outside, is about an inch in breadth, but below about an inch and a half, from the angle towards the chin. In consequence of this extent of insertion, the fibres of this portion divaricate very considerably. They are mostly fleshy at their insertion, a few only being tendinous, particularly those that are inserted backwards. The posterior and inner portion of the masseter is narrower at its insertion than at its origin: its posterior fibres running forwards as well as downwards, while its anterior run almost directly downwards. It occupies in its insertion the remaining part of the scabrous surface above the angle of the lower jaw, which lies between the anterior portion and the two upper processes, viz. the condyle and coronoid. As the anterior fibres of this portion rise on the inside of the posterior fibres of the other portion, and as its posterior fibres run forwards as well as downwards, and its ante-

rior run almost directly downwards, while the fibres of the other portion radiate both forwards and backwards; these two portions in some measure decussate, or cross one another. The anterior fibres, which run furthest and lowest down, are tendinous at their insertion, while the posterior and shortest are fleshy.

The use of the whole muscle is to raise the lower jaw; and when it is brought forwards, the posterior and inner portion will assist in bringing it a little back: so that this muscle becomes a rotator, if the jaw happens to be turned to the opposite side.

We may observe that this muscle is intermixed with a number of tendinous portions, both at its origin and its insertion; which give rise to a greater number of fleshy fibres, and thereby add to the strength of the muscle.

Of the Temporal Muscle.

The temporal muscle is situated on the side of the head, above and a little before the ear. It is a flat and radiated muscle; broad and thin at its origin; narrow and thick at its insertion; and covered with a pretty strong fascia above the jugum.

This fascia is fixed to the bones round the whole circumference of the origin of the muscle. Above, it is fixed to a smooth white line, which is observable upon the skull, extending from a little ridge on the lateral part of the os frontis, continued across the parietal bone, and making a turn towards the mammillary process. It is fixed below to the ridge where the zygomatic process begins, just above the meatus auditorius; then to the upper edge of the zygomatic process itself, and anteriorly to the os malæ. This adhesion above, before, and behind, describes, as it were, the circumference of the origin of the temporal muscle.

This muscle arises from all the bones of the side of the head that are within the line for insertion of the tendinous fascia, viz. from the lower and lateral part of the parietal bone, from all the squamous portion of the temporal bone, from the lower and lateral part of the os frontis, from the temporal process of the os sphenoides, often from a process at the lower part of this surface (which portion, however, is often common to this muscle and the pterygoideus externus), and from the posterior surface of the os malæ: outwardly, it arises from the inner surface of the jugum, and from the whole inner surface of the fascia. At this origin from the jugum it is not to be distinguished from the masseter, being there in fact one and the same muscle; and indeed the masseter is no more than a continuation of the same origin under the edge of the jugum, and might properly enough be reckoned the same, both as to its origin and insertion, and in some measure in its use also.

The origin is principally fleshy, and the muscle passes from thence downwards and a little forwards, converging, and forming a thin middle tendon: after which the muscle runs downwards on

the inside of the jugum, and is inserted into the coronoid process of the lower jaw, on both sides tendinous and fleshy, but principally tendinous. It reaches further down upon the inside of the coronoid process than upon the outside, the insertion being continued as low down as the body of the bone.

The posterior and inferior edge of this muscle passes over the root of the zygomatic process of the temporal bone as over a pulley, which confines the action of the muscle to that of raising the lower jaw more than if its fibres had passed in a direct course from their origin to their insertion.

The use of the temporal muscle, in general, is to raise the lower jaw; and as it passes a little forwards to its insertion, it must bring the condyle at the same time backwards, and so counteract the pterygoideus externus of the opposite side; and if both muscles act, they counteract both the pterygoidei, by bringing back the whole of the jaw.

Of the Internal Pterygoid Muscle.

The internal pterygoid muscle is situated upon the inside of the lower jaw, opposite to the masseter. It is a strong short muscle, a little flattened, especially at its insertion. It arises tendinous and fleshy from the whole internal surface of the external ala of the sphenoid bone; from the external surface of the internal ala, near its bottom; from that process of the os palati that makes part of the fossa pterygoidea; likewise from the anterior rounded surface of that process where it is connected to the os maxillare superius. From thence the muscle passes downwards, a little outwards and backwards, and is inserted, tendinous and fleshy, into the inside of the lower jaw, from the angle up almost to the groove for the admission of the maxillary nerve, where the surface of the bone is remarkably scabrous.

The use of this muscle is to raise the lower jaw; and from its direction, one would suspect that it would bring the condyle a little forwards; but this motion is contrary to that of the lower jaw, for it is naturally brought back when raised.

Of the External Pterygoid Muscle.

The external pterygoid muscle is situated immediately between the external surface of the external ala of the pterygoid process and the condyle of the lower jaw, lying, as it were, horizontally along the basis of the skull. It is somewhat radiated in some bodies; broad at the origin, and small at the insertion; but the greater part of it forms a round strong fleshy belly, so that the part that makes it of the radiated kind is thin.

The thick and ordinary portion of it arises, tendinous and fleshy, from almost the whole external surface of the external ala of the

pterygoid process of the sphenoid bone, excepting a little bit of the root at the posterior edge; and towards the lower part it arises a little from the inner surface of that ala. The thin portion arises from a ridge of the sphenoid that is continued from the process towards the temple, just behind the foramen lacerum inferius, which terminates in a little protuberance. This origin is sometimes wanting, and in that case the temporal muscle arises from that protuberance; and very often this origin is common to both. These two origins of this muscle are sometimes so much separated as to make it a biceps.

From these origins the muscle passes outwards and a little backwards, converging; that is, the superior fibres passing outwards and backwards, and a little downwards; while the inferior or larger portion of it passes a little upward.

It is inserted, tendinous and fleshy, into a depression on the anterior part of the condyle and neck of the lower jaw, upon the inside of that ridge which is continued from the coronoid process; a little portion is likewise inserted into the anterior part of the moveable cartilage of the joint.

When this muscle acts singly, it is a rotator; for it brings the condyle of the jaw forwards, and likewise the moveable cartilage, which throws the chin to the opposite side; but if it acts in conjunction with its fellow of the opposite side, instead of being turned to one side, the whole jaw is brought forwards, and thus these counteract the temporal, &c.

These two muscles generally act alternately; and when they do so, one acts at the time of depression, the other at the time of elevation; so that these muscles act both when the lower jaw is raised and when it is depressed; although they do not assist in this act.

Of the Superior Digastric Muscle.

The digastricus is situated immediately under and a little upon the inside of the lower jaw, and exterior to the fauces, extending from the mastoid process to the chin, nearly along the angle made by the neck and chin, or face. The name of this muscle expresses its general shape, as it has two fleshy bellies, and of course a middle tendon. Yet some of its anterior belly does not arise from the tendon of the posterior, but from the fascia which binds it to the os hyoides. These two fleshy bellies do not run in the same line, but form an angle, just where the tendon runs into the anterior belly; so that this tendon seems rather to belong to the posterior, which is the thickest and longest.

This muscle arises from the sulcus made by the inside of the mastoid process, and a ridge upon the temporal bone, where it is united with the os occipitis. The extent of this origin is about an inch; it is fleshy upon its outer part, viz. that from the mastoid process, and tendinous on the inside from the ridge. From its

origin it passes forwards, downwards, and a little inwards, much in the direction of the posterior edge of the mammillary process, and forms a round tendon, first in its centre and upper surface. This tendon passes on in the same direction; and when got near the os hyoides, commonly perforates the anterior end of the stylo-hyoideus muscle. From the lower edge of this tendon some fibres seem to go off, which degenerate into a kind of fascia, which binds it to the os hyoides; while some go across the lower part of the mylo-hyoideus, and joining their fellows on the opposite side, bind the os hyoides by a kind of belt. At this part the tendon becomes a little broader, makes a turn upwards, inwards, and forwards, and giving origin to the anterior belly, passes on, in the same direction, to the lower part of the chin, where it is inserted, tendinous and fleshy, into a slight depression on the under and a little on the posterior part of the lower jaw, almost contiguous to its fellow. Besides the attachment of the middle tendon to the os hyoides, there is a ligamentous binding, which serves in some measure as a pulley. This is more marked in some subjects than in others; and this depends on the strength of the tendinous expansion which binds the tendon of the digastricus to the os hyoides.

When we say that these parts are attached to the os hyoides, we do not mean that they can be traced quite into it, like some other tendons in the body; but the os hyoides seems to be the most fixed point of attachment. Very often we find two anterior bellies to each muscle: the uncommon one, which is the smallest, does not pass to the chin, but joins with a similar portion on the other side, in a middle tendon, which is often fixed to the os hyoides. At other times we find such a portion on one side only, in which case it is commonly fixed to the middle tendon of the mylo-hyoideus.

The use of these muscles with regard to the lower jaw is principally to depress it; but according as one acts a little more forcibly than the other, it thereby gives the jaw a small rotation, and becomes in that respect a kind of antagonist to the pterygoideus externus. Besides depressing the lower jaw, when we examine the dead body, they would appear to raise the larynx. But although they have this effect, a proper attention to what happens in the living body will probably show that their principal action is to depress the lower jaw, and that they are the muscles commonly employed for this purpose. Let a finger be placed on the upper part of the sterno-mastoideus muscle, just behind the posterior edge of the mastoid process, about its middle, touching that edge a little with the finger; then depress the lower jaw; and the posterior head of the digastricus will be felt to swell very considerably, so as to point out the direction of the muscle. In this there can be no deception, for there is no other muscle in this part that has the same direction; and those who are of opinion that the digastricus does not depress the lower jaw will more readily allow this when they are told that we find the same head of the muscle act in deglutition; but not with a force equal to that which it exerts in depressing the

lower jaw. Further, if the sterno-hyoidei, sterno-thyroidei, and costo-hyoidei, acting at the same time with the mylo-hyoidei and genio-hyoidei, assisted in depressing the jaw, the os hyoides and thyroid cartilage would probably be depressed as the bellies of the sterno-hyoidei and of the other lower muscles are by much the longest; but, on the contrary, we find that the os hyoides, with the thyroid cartilage, is a little raised in the depression of the jaw, which we may suppose to be done by the anterior belly of the digastricus; and, secondly, if these muscles were to act to bring about this motion of the jaw, these parts would be brought forwards, nearer to the straight line between the chin and sternum, which is not the case in this action; whereas we find it to be the case in deglutition, in which these evidently act. By applying our fingers upon the genio-hyoideus and mylo-hyoideus, near the os hyoides, between the two anterior bellies of the digastricus (not near the chin, where the action of these two bellies may occasion a mistake), we find these muscles quite flaccid, which is not the case in deglutition nor in speaking, in which they certainly do act; nor do we find the muscles under the os hyoides at all affected, as they are in the motion of the larynx.

It has been observed that when we open the mouth, while we keep the lower jaw fixed, the fore part of the head or face is necessarily raised. Authors have been at a good deal of pains to explain this. Some of them considered the condyles of the jaw as the centre of motion. But if this were the case, that part of the head where it articulates with the spine, and consequently the whole body, must be depressed in proportion as the upper jaw is raised, which is not true in fact. Others have considered the condyles of the occiput as the centre of motion; and they have conceived the extensor muscles of the head to be the moving powers. The muscles which move the head in this case are pointed out by two circumstances which attend all muscular motion; in the first place, all actions of our body have muscles immediately adapted to them; and, secondly, when the mind wills any particular action, its power is applied by instinct to those muscles only which are naturally adapted to that motion; and further, the mind being accustomed to see the part move which is naturally the most moveable, attends to its motion in the volition, although it be in that instance fixed, and the other parts of the body move towards it; and although the other parts of the body might be brought towards it by other muscles, and would be so if the mind intended they should come towards it, yet these muscles are not brought into action. Thus, the flexors of the arm commonly move the hand to the body, but if the hand be fixed, the body is moved by the same muscles to the hand. In this case, however, the mind wills the motion of the hand towards the body, and brings the flexors into action; whereas, if it wished to bring the body towards the hand, the muscles of the fore part of the body would be put into action, and this would produce the same effect.

To apply this to the lower jaw: when we attempt to open the mouth while the lower jaw is immoveable, we fix our attention upon the very same muscles (whatever they are) which we call into action when we depress the lower jaw, and we find that we act with the very same muscles; for our mind attends to the depressing of the jaw, and not the raising of the face, and under such circumstances the mouth is actually opened. We find then by these means the head is raised; and the idea that we have of this motion is the same that we have in the common depression of the jaw; and we should not know, except from circumstances, that the jaw was not really depressed; we find also at this time that the extensors of the head are not in action. On the contrary, when the jaw is fixed in the same situation, if we have a mind to raise the head or upper jaw, which of course must open the mouth, we fix our attention to the muscles that move the head backwards without having the idea of opening our mouth; and at this time the extensors of the head act. This plainly shows that the same muscles which depress the jaw when moveable, must raise the head when the jaw is kept fixed.

This is a proof too that there are no other muscles employed in depressing the lower jaw than what will raise the head under the circumstances mentioned. This will further appear from the structure of the parts; wherein four things are to be considered, viz. the articulation of the jaw; the articulation of the head with the neck; the origin and the insertion of digastric muscle.

Suppose the upper jaw to be fixed, and the lower jaw to be moveable on the condyle, if the digastric contracts, its origin and insertion will approach towards one another; in which case it is evident that the lower jaw will move downwards and backwards. But if the lower jaw be fixed, as in the case supposed, and the vertebra also, the condyle will move upwards and forwards upon the eminence in the joint, the fore part of the head will be pushed upwards and backwards by the condyle, and the hind part of the head will be drawn down; so that the whole shall make a kind of circular motion upon the upper vertebræ; and the digastric muscle, pulling the hind part of the head towards the lower jaw, and at the same time pushing up the condyles against the fore part of the head, acquires by this mechanism a very considerable additional power.

Of the Structure of a Tooth; and, first, of the Enamel.

A tooth is composed of two substances, viz. enamel and bone. The enamel, called likewise the vitreous or cortical part, is found only upon the body of the tooth, and is there laid all round on the outside of the bony or internal substance.* It is by far the hardest part of our body; insomuch that the hardest and sharpest saw will scarce make an impression upon it, and we are obliged to use a file

* Pl. III. f. 15, 16, 18.

in dividing or cutting it. When it is broken it appears fibrous or striated, and all the fibres or striæ are directed from the circumference to the centre of the tooth.*

This in some measure prevents it from breaking in mastication, as the fibres are disposed in arches, and also keeps the tooth from wearing down, as the ends of the fibres are always acting on the food.

The enamel is thickest on the grinding surface and on the cutting edges or points of the teeth, and becomes gradually thinner on the sides as it approaches the neck, where it terminates insensibly, though not equally low, on all sides of the teeth.† On the base or grinding surface it is of a pretty equal thickness, and therefore is of the same form with the bony substance which it covers.‡

It would seem to be an earth united with a portion of animal substance, as it is not reducible to quick-lime by fire till it has first been dissolved in an acid. When a tooth is put into a weak acid, the enamel to appearance is not hurt; but on touching it with the fingers it crumbles down into a white pulp. The enamel of teeth, exposed to any degree of heat, does not turn to lime: it contains animal mucilaginous matter; for when exposed to the fire it becomes very brittle, cracks, grows black, and separates from the inclosed bony part of the tooth. It is capable, however, of bearing a greater degree of heat than the bony part, without becoming brittle and black.§ This substance has no marks of being vascular and of having a circulation of fluids: the most subtile injections we can make never reach it; it takes no tinge from feeding with madder, even in the youngest animals; and, as was observed above, when soaked in a gentle acid there appears no gristly or fleshy part with which the earthy part had been incorporated.‖

We shall speak of the use and formation of the enamel hereafter, when they will be better understood.¶

* Pl. III. f. 22, 23, 24. † Ibid. ‡ Ibid.

§ From this circumstance we can show the enamel better by burning a tooth, as the bony part becomes black sooner than the enamel. The method of burning, and showing them after they are burnt, is as follows: Let one half of a tooth be filed away, from one end to another, then burn it gently in the fire; after this is done, wash the filed surface with an acid, or scrape it with a knife. By this method you will clean the edge of the enamel, which will remain white, and the bony part will be found black.

‖ In all these experiments I never could observe that the enamel was in the least tinged, either in the growing or formed tooth. This looks as if the enamel were the earth more fully depurated, or strained off, from the common juices in such a manner as not to allow the gross particles of madder to pass. Here it may not be amiss to remark, that the names given to animal substance, such as gluten, &c., are not in the least expressive of the thing meant, for there is no such thing as glue in an animal till it has either undergone a putrefactive process or been changed by heat. And here, too, I wish it to be understood that I do not consider earth as any part of an animal, or that it makes up any part of an animal substance.

¶ [The structure of the enamel is perfectly crystalline. The crystals are fibrous in appearance, and placed parallel to each other, at right angles with the surface

Of the Bony Part of a Tooth.

The other substance of which a tooth is composed is bony, but much harder than the most compact part of bones in general. This substance makes the interior part of the body, the neck, and the whole of the root of a tooth. It is a mixture of two substances, viz. calcareous earth and an animal substance, which we might suppose to be organized and vascular. The earth is in very considerable quantity: it remains of the same shape after calcination, so that it is in some measure kept together by cohesion; and it is capable of being extracted by steeping in the muriatic and some other acids. The animal substance, when deprived of the earthy part by steeping in an acid, is more compact than the same substance in other bones, but still is soft and flexible.

That part of a tooth which is bony has nearly the same form as a complete tooth; and hence, when the enamel is removed, it has the same sort of edge or points as the enamel itself. We cannot by injection prove that the bony part of a tooth is vascular; but from some circumstances it would appear that it is so; for the fangs of teeth are liable to swellings, seemingly of the spina ventosa kind, like other bones, and they sometimes anchylose with the socket by bony and inflexible continuity, as all other contiguous bones are apt to do. But there may be a deception here, for the swelling may be an original formation, and the anchylosis may arise from the pulp, upon which the tooth is formed, being united with the socket. The following considerations would seem to show that the teeth are not vascular: first, I never saw them injected in any preparation, nor could I ever succeed in any attempt to inject them, either in young or old subjects, and therefore believe that there must have been some fallacy in the cases where they have been said to be injected. Secondly, we are not able to trace any vessels going from the pulp into the substance of a new-formed tooth; and whatever part of a tooth is formed, it is always completely formed which is not the case with other bones. But, reasoning from analogy, we have a still more convincing proof in the effect of madder. Take, for example, any young animal, as a pig, and feed it with madder for three or four weeks; then kill the animal, and upon examination you will find the following appearances: first, if this animal had some parts of its teeth formed before

of the bony portion of the tooth with which their inner terminations are placed in contact. It is true that there is a trace of animal matter in this substance, according to the following analysis by Berzelius:

Phosphate of lime	85·3
Fluate of lime	3·2
Carbonate of lime	8·
Phosphate of magnesia	1·5
Soda and muriate of soda	1·
Animal matter and water	1·
	100·]

the feeding with madder, those parts will be known by their remaining of the natural colour; but such parts of the teeth as were formed while the animal was taking the madder will be found to be of a red colour. This shows that it is only those parts that were formed while the animal was taking the madder that are dyed; for what were already formed will not be found in the least tinged. This is different in all other bones, for we know that any part of a bone which is already formed is capable of being dyed with madder, though not so fast as the part that is forming; therefore, as we know that all other bones when formed are vascular, and are thence susceptible of the dye, we may readily suppose that the teeth are not vascular, because they are not susceptible of it after being once formed. But we shall carry this still further: if you feed a pig with madder for some time, and then leave it off for a considerable time before you kill the animal, you will find the above appearances still subsisting, with this addition, that all the parts of the teeth which were formed after leaving off feeding with the madder will be white. Here then in some teeth we shall have white, then red, and then white again; and so we shall have the red and white colour alternately through the whole tooth.

This experiment shows that the tooth, once tinged, does not lose its colour: now as all other bones that have not been tinged lose their colour in time, when the animal leaves off feeding with madder (though very slowly), and as that dye must be taken into the constitution by the absorbents, it would seem that the teeth are without absorbents as well as other vessels.

This shows that the growth of the teeth is very different from that of other bones. Bones begin at a point, and shoot out at their surface, and the part that seems already formed is not in reality so, for it is forming every day by having new matter thrown into it, till the whole substance is complete; and even then it is constantly changing its matter.

Another circumstance in which teeth seem different from bone, and a strong circumstance in support of their having no circulation in them, is, that they never change by age, and seem never to undergo any alteration when completely formed but by abrasion: they do not grow softer, like the other bones, as we find in some cases, where the whole earthy matter of the bones has been taken into the constitution.

From these experiments it would appear that the teeth are to be considered as extraneous bodies, with respect to a circulation through their substance; but they have most certainly a living principle, by which means they make part of the body, and are capable of uniting with any part of a living body, as will be explained hereafter. It is to be observed, that affections of the whole body have less influence upon the teeth than any other part of the body. Thus, in children affected with the rickets, the teeth grow equally well as in health, though all the other bones are much

affected; and hence their teeth being of a larger size in proportion to the other parts, their mouths are protuberant.*

Of the Cavity of the Teeth.

Every tooth has an internal cavity, which extends nearly the whole length of its bony part.† It opens or begins at the point of the fang, where it is small; but in its passage it becomes larger, and ends in the body of the tooth;‡ the cavity at this end is exactly of the shape of the body of the tooth to which it belongs; and in

* [As the arguments which are here adduced against the vascularity of the teeth are wholly insufficient, and in many respects inconsistent with each other, it will be useful to examine into the true bearing of the observations on which they are founded.

The failure of all attempts to inject the substance of the teeth, when even the finest of the matters usually employed for filling the minute branches of arteries in other structures of the body, can scarcely be considered as conclusive, since the colouring matter is, in all of them, too dense and coarse to pass into the vessels of many other parts, which, though in the healthy condition they do not convey red blood, yet in a state of inflammation, become evidently injected with red particles. I have, however, on another occasion, alluded to two very conclusive facts, which appear unanswerably to prove the vascularity of the teeth. One is the occasional occurrence of red patches in the otherwise healthy bony structure of a tooth when much inflamed, discoverable by breaking or sawing asunder the body of the tooth immediately after extraction. The other, the injection of a tooth with bile in cases of jaundice, of which I have seen more than one example. In the former instance, the red patches are of rather a bright colour, until they become dull and obscure by time; and in the latter the whole substance of the tooth is imbued with a bright yellow colour.

The experiments on madder would be far from conclusive on the point at issue, even were the details more complete. In the absence, however, of all information respecting the duration of each experiment, and especially the period which elapsed after the madder had been discontinued before the animal was killed, it would be futile to combat the conclusions which Hunter has deduced from them. Thus deficient, they only prove that the more highly organized bones, as might be expected, lose the colouring matter of the madder by absorption sooner than the teeth. The paragraph in which the results are summed up is perhaps as characteristic of the peculiar tendencies of Hunter's mind as any that can be found in his works. Concluding, from the failure of his experiments with madder, and from other peculiarities, that the teeth are devoid of a circulation through their substance, and therefore to be so far considered as extraneous bodies, his intense love of truth, which never suffered him even to escape from a dilemma by its slightest sacrifice, forces him to confess the existence of a living principle, because he found, from the result of other experiments, that they "were capable of uniting with any part of a living body." Instead, therefore, of endeavouring to render his theory consistent with itself, by disguising or perverting one of the two incompatible conclusions to which his observations had forced him, he adopts them both, and is thus driven to the inference, that an organ can, at the same time, be "an extraneous body," and yet possess "a living principle," and be "capable of uniting with any part of a living body."

The truth appears to be, that the teeth are truly organized bodies, having nerves and absorbent and circulating vessels, but possessing so low a degree of living power, and so dense a structure, as to exhibit phenomena, both in their healthy and diseased condition, which are very dissimilar from those which are observed in true osseous structures.]

† Pl. III. f. 1, 2, 3, &c.

‡ Ibid.

general it may be said that the whole of the cavity is nearly of the shape of the tooth itself, larger, that is, in the body of the tooth, and thence gradually smaller to the extremity of the fang; simple where the tooth has but one root,* and in the same manner compounded when the tooth has two or more fangs.†

This cavity is not cellular, but smooth in its surface: it contains no marrow, but appears to be filled with blood-vessels,‡ and, I suppose, nerves, united by a pulpy or cellular substance. The vessels are branches of the superior and inferior maxillaries, and the nerves must come from the second and third branches of the fifth pair.

By injections we can trace the blood-vessels distinctly through the whole cavity of the tooth; but I could never trace the nerves distinctly even to the beginning of the cavity.

Of the Periosteum of the Teeth.

The teeth, as we have observed, are covered by an enamel only at their bodies; but at their fangs they have a periosteum, which, though very thin, is vascular, and appears to be common to the tooth which it incloses, and the socket, which it lines as an investing internal membrane. It covers the tooth a little beyond the bony socket, and is there attached to the gum.§

Of the Situation of the Teeth.

The general shape and situation of the teeth are obvious. The opposition of those of the two jaws, and the circle which each row describes, need not be particularly explained, as they may be very well seen in the living body, and may be supposed to be already understood from what has been said of the alveolar processes.

We may just observe, with regard to the situation of the two rows, that when they are in the most natural state of contact, the teeth of the upper jaw project a little beyond the lower teeth, even at the sides of the jaws, but still more remarkably at the fore part, where, in most people, the upper teeth lie before those of the lower jaw;‖ and at the lateral part of each row the line or surface of contact is hollow from behind forwards in the lower jaw, and in the same proportion it is convex in the upper jaw.¶

The edge of each row is single at the fore part of the jaws; but as the teeth grow thicker backwards, it there splits into an internal

* Pl. III. f. 4, 5, 6, 7. † Pl. III. f. 1, 2. ‡ Pl. V. f. 7, 8.

§ [The periosteum can hardly be said to be common to the tooth and the socket. It is, in fact, continued from the external surface of the alveolar process into the socket, and then reflected over the surface of the root. Thus, if a healthy tooth be removed from a dead body, it will be found covered with an extremely thin periosteum, and the alveolar cavity will also often remain lined by a similar structure. Probably when inflammation has once existed to a considerable degree in this membrane, the two layers become permanently united.]

‖ Pl. I. f. 1, 2. ¶ Ibid.

and external edge. The canine tooth, which we shall call cuspidatus, is the point from which the two edges go off, so that the first grinder, or what we shall call the first bicuspis, is the first tooth that has a double edge.*

Of the Number of the Teeth.

Their number in the whole, at full maturity, is from twenty-eight to thirty-two: I once saw twenty-seven only; never more than thirty-two. Fourteen of them are placed in each jaw when the whole number is no more than twenty-eight, and sixteen when there are thirty-two. If the whole be twenty-nine or thirty-one in number, the upper jaw sometimes, and sometimes the lower, has one more than the other; and when the number is thirty, I find them sometimes divided equally between the two jaws; and in other subjects sixteen of them are in one jaw and fourteen in the other. In speaking of the number of teeth, I am supposing that none of them have been pulled out, or otherwise lost; but that there are from eight to twelve of those large posterior teeth, which I call grinders, and that they are so closely planted as to make a continuity in the circle; and in this case, when the number is less than thirty-two, the deficiency is in the last grinder.

The teeth differ very much in figure from one another, but those on the right side in each jaw resemble exactly those on the left, so as to be in pairs; and the pairs belonging to the upper jaw nearly resemble the corresponding teeth of the lower jaw in situation, figure, and use.†

Each tooth is divided into two parts, viz. first, the body, or that part of it which is the thickest, and stands bare beyond the alveoli and gums; secondly, the fang, or root, which is lodged within the gum and alveolar process: and the boundary between these two parts, which is grasped by the edge of the gum, is called the neck of a tooth. The bodies of the different teeth differ very much in shape and size, and so do their roots. The difference must be considered hereafter.

The teeth of each jaw are commonly divided into *three* classes, viz. Incisors, Canine, and Grinders; but from considering some circumstances of their form, growth, and use, I choose to divide them into the *four* following classes, viz. Incisores, commonly called fore teeth; Cuspidati, vulgarly called canine; Bicuspides, or the first two grinders; and Molares, or the last three teeth. The number of each class in each jaw, for the most part is four incisores, two cuspidati, four bicuspides, and four, five, or six molares.

There is a regular gradation, both in growth and form, through these classes, from the incisores to the molares; in which respect the cuspidati are of a middle nature between the incisores and bicuspides, just as the last-mentioned are intermediate between the

* Pl. II. f. 1, 2. † Pl. I. & II. and Pl. III. row 1, 2, 3, 4.

cuspidati and molares: consequently the incisores and molares are the most unlike in every circumstance.*

Of the Incisores.

The incisores are situated in the anterior part of the jaw; the others more backwards on each side, in the order in which we have named them. The bodies of the incisores are broad, having two flat surfaces, one anterior, the other posterior. These surfaces meet in a sharp cutting edge. The anterior surface is convex in every direction, and placed almost perpendicularly; and the posterior is concave and sloping, so that the cutting edge is almost directly over the anterior surface.†

These surfaces are broadest, and the tooth is thinnest, at the cutting edge or end of the tooth, and thence they become gradually narrower and the root thicker towards the neck, where the surfaces are continued to the narrowest side or edge of the fang. The body of an incisor, in a side view, grows gradually thicker or broader from the edge of the tooth to its neck; and these coincide with the flat or broad side of the fang: so that when we look on the fore or back part of an incisor, we observe it grows constantly narrower from its cutting edge to the extremity of its fang. But in a side view it is thickest or broadest at its neck, and thence becomes gradually more narrow, both to its cutting edge and to the point of its fang.‡

The enamel is continued further down, and is thicker on the anterior and back part of the incisores than on their sides, and is even a little thicker on the fore part than upon the back part of the tooth. If we view them laterally, either entire or when cut down through the middle, but especially in the latter case, it would seem as if the fang was driven like a wedge into and had split the body or enamel of the tooth.§ They stand almost perpendicularly, their bodies turned a little forwards. Their fangs are much shorter than those of the cuspidati, but pretty much of the same length with all the other teeth of this jaw.‖

In the upper jaw they are broader and thicker, especially the two first: their length is nearly the same with those of the lower jaw. they stand a little obliquely, with their bodies turned much more forwards (the first especially,) and they generally fall over those of the under jaw.

The two first incisores cover the two first and half of the second of the lower jaw, so that the second incisor of the upper jaw covers

* Pl. I. and Pl. III. f. 1. It is here to be understood that the teeth from which we take our description are such as are just completely formed, and not therefore in the least worn down by mastication. Our description of each class is taken from the lower jaw; and the difference between them and their corresponding classes in the upper jaw immediately follows that description.

† Pl. III. ‡ Ibid. § Ibid. f. 18. ‖ Pl. II. f. 4.

half of the second incisor and more than half of the cuspidatus of the under jaw.*

The edges of the incisores, by use and friction, in some people become blunt and thicker; and in others they sharpen one another, and become thinner.

Of the Cuspidatus.

The cuspidatus is the next after the incisores in each jaw, so that there are four of them in all. They are in general thicker than the incisores, and considerably the longest of all the teeth.†

The shape of the body of the cuspidatus may be very well conceived by supposing an incisor with its corners rubbed off, so as to end in a narrow point instead of a thin edge;‡ and the fang differs from that of an incisor only in being much larger.§

The outside of the body of a cuspidatus projects most at the side next the incisores, being there more angular than anywhere else.

The enamel covers more of the lateral parts of these teeth than of the incisores. They stand perpendicularly, or nearly so, projecting further out in the circle than the others, so that the two cuspidati and the four incisores often stand almost in a straight line, especially in the lower jaw.

This takes place only in adults, and in them only when the second teeth are rather too large for the arch of the jaw; for we never find this when the teeth are at any distance from one another, or in young subjects. Their points commonly project beyond the horizontal plane formed by the row of teeth, and their fangs run deeper into the jaws, and are oftener a little bent.

In the upper jaw they are rather longer, and do not project much beyond the circle of the adjacent teeth; and in this jaw they are not placed vertically, their bodies being turned a little forwards and outwards.

When the jaws are closed, the cuspidatus of the upper jaw falls between and projects a little over the cuspidatus and first bicuspis of the lower jaw. When they are a little worn down by use, they commonly first take an edge somewhat like a worn incisor, and afterwards become rounder.

The use of the cuspidati would seem to be to lay hold of substances, perhaps even living animals: they are not formed for dividing, as the incisores are, nor are they fit for grinding. We may trace in these teeth a similarity in shape, situation, and use, from the most imperfectly carnivorous animal, which we believe to be the human species, to the most perfectly carnivorous, viz. the lion.‖

* Pl. I. f. 1.
† Pl. II. f. 4; Plate III. row 1, *b*.
‡ Pl. II. f. 1, at *bb*.
§ Pl. II. f. 4.
‖ [That our conclusions as to the functions of an organ as it exists in man, when drawn exclusively from analogous structures in the lower animals, will frequently prove erroneous, is strikingly shown in these observations on the use

Of the Bicuspides.

Immediately behind the cuspidati, in each jaw, stand two teeth, commonly called the first and second grinders, but which, for reasons hinted at above, I shall suppose to constitute a particular class, and call them bicuspides.

These (viz. the fourth and fifth tooth from the symphysis of the jaw) resemble each other so nearly that a description of the first will serve for both. The first indeed is frequently the smallest, and has rather the longest fang, having somewhat more of the shape of the cuspidatus than the second.

The body of this tooth is flattened laterally, answering to the flat side of the fang. It terminates in two points, viz. one external and one internal. The external is the longest and thickest; so that on looking into the mouth from without, this point only can be seen, and the tooth has very much the appearance of a cuspidatus, especially the first of these teeth. The internal point is the least, and indeed sometimes so very small that the tooth has the greatest resemblance to a cuspidatus in any view.* At the union of the points the tooth is thickest, and thence it loses in thickness, from side to side, to the extremity of the fang, so that the fang continues pretty broad to the point, and is often forked there. All the teeth hitherto described often have their points bent, and more particularly the cuspidati.

The enamel passes somewhat further down externally and upon the inside, than laterally; but this difference is not so considerable as in the incisores and cuspidati; in some, indeed, it terminates equally all round the tooth. They stand almost perpendicularly, but seem to be a little turned inwards, especially the last of them.

In the upper jaw they are rather thicker than in the lower, and are turned a very little forwards and outwards. The first in the upper jaw falls between the two in the lower, the second falls between the second and the first grinder; and both project over those of the lower jaw, but less than the incisores and cuspidati.

The bicuspides, and especially the second of them, in both jaws, are oftener naturally wanting than any of the teeth, except the dentes sapientiæ; hence we might conjecture that they are less useful; and this conjecture appears less improbable when we consider that

of the cuspidatus. The simple and obvious use of this tooth, in the human species, is to tear such portions of food as are too hard or tough to be divided by the incisores; and we frequently find it even far more developed in animals which are known to be exclusively frugivorous. Not only is its structure wholly unadapted for such an object as that assigned to it in the text, but there is no analogous or other ground for supposing that man was originally constructed for the pursuit and capture of living prey. His naturally erect position and the structure of the mouth would render this impossible by the means inferred by Hunter, and the possession of so perfect an instrument as the hand obviates the necessity of his ever employing any other organ for the purpose of seizing or holding food of whatever description.]

* Pl. II. f. 1, 2, *c c*.

in their use they are of a middle nature between cutters and grinders, and that in most animals, so far as I have observed, there is a vacant space between the cutters and grinders. I have also seen a jaw in which the first bicuspis was of the same shape and size as a grinder, and projected, for want of room, between the cuspidatus and second bicuspis. These and the grinders alter very little in shape on their grinding surfaces by use; their points only wear down and become obtuse.

Of the Grinders.

In describing the grinders we shall first consider the first and second conjointly, because they are nearly the same in every particular, and then give an account of the third or last grinder, which differs from the former in some circumstances.

The two first grinders differ from the bicuspides principally in being much larger, and in having more points upon their body and more fangs.*

The body forms almost a square, with rounded angles. The grinding surface has commonly five points, or protuberances, two of which are on the inner, and three on the outer part of the tooth; and generally some smaller points at the roots of these larger protuberances. These protuberances make an irregular cavity in the middle of the tooth. The three outer points do not stand so near the outer edge of the tooth as the inner do on the inside; so that the body of the tooth swells out more from the points, or is more convex, on the outside. The body towards its neck becomes very little smaller, and there divides into two flat fangs, one forwards the other backwards, with their edges turned outwards and inwards, and their sides consequently forwards and backwards: the fangs are but very little narrower at their ends, which are pretty broad and often bifurcated. There are two cavities in each fang, one towards each edge leading to the general cavity in the body of the tooth. These two cavities are formed by the meeting of the sides of the fang in the middle, thereby dividing the broad and flat cavity into two;† and all along the outside of these (and all the other flat fangs) there is a corresponding longitudinal groove. These fangs at their middle are generally bent a little backwards.‡

The enamel covers the bodies of these teeth pretty equally all round.

The first grinder is somewhat larger and stronger than the second; it is turned a little more inwards than the adjacent bicuspides, but not so much as the second grinder. Both of them have generally shorter fangs than the bicuspides.

There is a greater difference between these grinders in the upper and lower jaw than between any of the other teeth. In the upper

* Pl. II. f. 1, 2, *d d*.

† Pl. III. f. 8, where four dark spots are observed.

‡ Pl. II. f. 4.

jaw they are rather rhomboidal than square in their body, with one sharp angle turned forwards and outwards, the other backwards and inwards; besides, they have three fangs, which diverge, and terminate each in a point: these are almost round, and have but one cavity. Two of them are placed near each other perpendicularly over the outside of the tooth; and the other, which generally is the largest, stands at a greater distance on the inside of the tooth, slanting inwards. In this jaw these two grinders are inclined outwards, and a little forwards; they project a little over the corresponding teeth of the lower jaw, and are placed further back in the mouth, so that each is partly opposed to two of the lower jaw. The second in the upper jaw is smaller than the others; and the first and second are placed directly under the maxillary sinus. I once saw the second grinder naturally wanting on one side of the lower jaw.

The third grinder is commonly called dens sapientiæ: it is a little shorter and smaller than the others, and inclined a little more inwards and forwards. Its body is nearly of the same figure, but rather rounder, and its fangs are generally not so regular and distinct, for they often appear squeezed together; and sometimes there is only one fang, which makes the tooth conical: it is much smaller than the rest of the grinders. In the upper jaw this tooth has more variety than in the lower, and is even smaller than the corresponding tooth of the lower, and consequently stands directly opposed to it: but for this circumstance the grinders would reach farther back in the upper jaw than in the lower, which is not commonly the case.

In the upper jaw this third grinder is turned but a very little outwards, is frequently inclined somewhat backwards, and projects over that of the under jaw. It oftener becomes loose than any of the other teeth.

It is placed under the posterior part of the maxillary sinus, where the parts which compose the sinus are thicker than in the middle. The variations as to the natural number of the teeth depend commonly upon the dentes sapientæ.

Thus, from the incisores to the first grinder, the teeth become gradually thicker at the extremity of their bodies, and smaller from the first grinder to the dens sapientiæ. From the cuspidatus to the dens sapientiæ the fangs become much shorter: the incisores are nearly of the same length with the bicuspides. From the first incisor to the last grinder the teeth stand less out from the sockets and gums.

The bodies of the teeth in the lower jaw are turned a little outwards at the anterior part of the jaw, and thence, to the third grinder, they are inclined gradually more inwards. The teeth in the upper jaw project over those of the under, especially at the fore part, which is owing to the greater obliquity of the teeth in the upper jaw; for the circle of the sockets is nearly the same in both jaws. This oblique situation, however, becomes gradually less, from the incisores backwards to the last grinder, which makes them gradually project less in the same proportion.

The teeth in the upper jaw are placed further back in the circle than the corresponding teeth of the lower; this is owing to the two first incisores above being broader than the corresponding incisores below. All the teeth have only one fang, except the grinders, each of which has two in the lower jaw and three in the upper.*

The fangs bear a proportion to the bodies of the teeth; and the reason is evident, for otherwise they would be easily broken, or pushed out of their sockets. The force commonly applied to them is oblique, not perpendicular; and they are not so firmly fixed in the upper jaw, that is, the alveolar process in that is not so strong, as in the under jaw: it is perhaps on this account that the grinders in that jaw have three fangs.

This particular structure in the alveolar process of the upper jaw is perhaps to give more room for the antrum Highmorianum. On this supposition the fangs must be made accordingly, *i. e.* so that they shall not be pushed into that cavity: now, by their diverging they inclose, as it were, the bottom of the antrum, and do not push against its middle, which is the weakest part; and the points of three diverging fangs will make a greater resistance (or not be so easily pushed in) than if they were placed parallel. If there had been only two, as in the lower jaw, they must have been placed opposite to the thinnest part of the antrum; and three points placed in any direction but a diverging one would have had here much the same effect as two; and as the force applied is endeavouring to depress the tooth, and push it inwards, the innermost fang diverges most, and is supported by the inner wall of the antrum. That all this weakness in the upper jaw is for the increase of the antrum is probable, because all the teeth in the upper jaw are a good deal similar to those in the lower, excepting those that are opposite to the maxillary sinus; and here they differ principally in the fangs, without any other apparent reason: and what confirms this is, that the dentes sapientiæ in both jaws are more alike than the other grinders,—for this reason, as I apprehend, because the dens sapientiæ in the upper jaw does not interfere so much with the maxillary sinus.

What makes it still more probable that the two first superior grinders have three fangs on account of the maxillary sinus is, that the two grinders on each side of the upper jaw, in the child, have three fangs, and we find them underneath the antrum; but those that succeed them have only one fang, as in the lower jaw; but by that time the antrum has passed further back, or rather the arch of the jaw has projected, or shot forwards, as it were, from under the antrum, so that the alveolar processes that were under it at one age are got before it in another.

That the edge of every fang is turned towards the circumference

* Those anatomists who allow the teeth to have more fangs have been led into a mistake; I suppose, by often observing two canals in one fang, and thence concluding that such a fang was originally two, and that these were now grown together.

of the jaw, in order to counteract the acting power, we shall see when we consider the motion of the jaw and the use of the teeth.

Of the Articulation of the Teeth.

The fangs of the teeth are fixed in the gum and alveolar processes by that species of articulation called gomphosis, which in some measure resembles a nail driven into a piece of wood.*

They are not, however, firmly united with the processes, for every tooth has some degree of motion; and in heads which have been boiled or macerated in water, so as to destroy the periosteum and adhesion of the teeth, we find the teeth so loosely connected with their sockets that all of them are ready to drop out, except the grinders, which remain, as it were, hooked from the number and shape of their fangs.

Of the Gums.

The alveolar processes are covered by a red vascular substance, called the gums, which has as many perforations as there are teeth, and the neck of a tooth is covered by and fixed to this gum. Hence there are fleshy partitions between the teeth, passing between the external and internal gum, and, as it were, uniting them: these partitions are higher than the other parts of the gum, and form an arch between every two adjacent teeth. The thickness of that part of the gum which projects beyond the sockets is considerable, so that when the gum is corroded by disease, by boiling, or otherwise, the teeth appear longer, or less sunk into the jaw. The gum adheres very firmly in a healthful state both to the alveolar process and to the teeth, but its extreme border is naturally loose all around the teeth. The gum, in substance, has something of a cartilaginous hardness and elasticity, and is very vascular, but seems not to have any great degree of sensibility; for though we often wound it in eating, and in picking our teeth, yet we do not feel much pain upon these occasions; and both in infants and old people, where there are no teeth, the gums bear a very considerable pressure without pain.

The advantage arising from this degree of insensibility in the gums is obvious, for till the child cuts its teeth the gums are to do the business of teeth, and are therefore formed for this purpose, having a hard ridge running through their whole length. Old people who have lost their teeth have not this ridge. When in a sound state, the gums are not easily irritated by being wounded, and therefore are not so liable to inflammation as other parts, and soon heal.

The teeth being united to the jaw by the periosteum and gum, have some degree of a yielding motion in the living body. This

* See Pl. II. f. 4, for the teeth themselves in their sockets.

circumstance renders them more secure; it breaks the jar of bony contact, and prevents fractures both of the sockets and of the teeth themselves.

Of the Action of the Teeth, arising from the Motion of the Lower Jaw.

The lower jaw may be said to be the only one that has any motion in mastication, for the upper jaw can only move with the other parts of the head. That the upper jaw and head should be raised in the common act of opening the mouth or chewing, would seem, at first sight, improbable; and from an attentive view of the mechanism of the joints and muscles of those parts, from experiment and observation, we find that they do not sensibly move. We shall only mention one experiment in proof of this, which seems conclusive. Let a man place himself near some fixed point, and look over it, to another distant and immoveable object, when he is eating. If his head should rise in the least degree he would see more of the distant object over the nearest fixed point, which in fact he does not. The nearer the fixed point is, and the more distant the object, the experiment will be more accurate and convincing. The result of the experiment will be the same if the nearest point has the same motion with the head, as when he looks from under the edge of a hat, or anything else put upon his head, at some distant fixed object. We may conclude, then, that the motion is entirely in the lower jaw; and, as we have already described both the articulation and the motion of the bone, we shall now explain the action of mastication, and at the same time consider the use of each class of teeth.

With regard to the action of the teeth of both jaws in mastication, we may observe once for all that their action and reaction must be always equal, and that the teeth of the upper and lower jaws are complete and equal antagonists both in cutting and grinding.

When the lower jaw is depressed, the condyles slide forwards on the eminences, and they return back again into the cavities when the jaw is completely raised. This simple action produces a grinding motion of the lower jaw, backwards on the upper, and is used when we divide anything with our fore teeth, or incisores. For this purpose the incisores are well formed: for as they are higher than the others, their edges must come in contact sooner; and as the upper project over the under, we find, in dividing any substance with them, that we first bring them opposite to one another, and as they pass through the part to be divided, the lower jaw is brought back, while the incisores of that jaw slide up behind those of the upper jaw, and of course pass by one another. In this way they complete the division, like a pair of scissors, and at the same time they sharpen one another. There are exceptions to this, for these teeth in some people meet equally, viz. in those people whose fore

teeth do not project further from the gum, or socket, than the back teeth; and such teeth are not so fit for dividing: and in some people the teeth of the lower jaw are so placed as to come before those of the upper jaw. This last situation is as favourable for cutting as when the overlapping of the teeth is the reverse, except for this circumstance, that the lower jaw must be longer, and therefore its action weaker.

The other motion of the lower jaw, viz. when the lateral teeth are used, is somewhat different from the former. In opening the mouth one condyle slides a little forwards, and the other slides a little further back into its cavity; this throws the jaw a little to that side, just enough to bring the lower teeth directly under their corresponding teeth in the upper jaw: this is done either in dividing or holding of substances, and these are the teeth that are generally used in the last-mentioned action. When the true grinding motion is to be performed, a greater degree of this last motion takes place; that is, the condyle of the opposite side is brought further forwards, and the condyle of the same side is drawn further back into the cavity of the temporal bone, and the jaw is a little depressed. This is only preparatory for the effect to be produced, for the moving back of the first-mentioned condyle into the socket is what produces the effect in mastication.

The lateral teeth in both jaws are adapted to this oblique motion. In the lower they are turned a little inwards, that they may act more in the direction of their axis; and here the alveolar process is strongest upon the outside, being there supported by the ridge at the root of the coronoid process. In the upper jaw the obliquity of the teeth is the reverse, that is, they are turned outwards, for the same reason; and the longest fang of the grinders is upon the inside, where the socket is strengthened by the bony partition between the antrum and nose. Hence it is that the teeth of the lower jaw have their outer edges worn down first, and *vice versâ* in the upper jaw.

General Comparisons between the Motion of the Jaw in young and in old People.

In children who have not yet teeth there does not seem to be a sliding motion in the lower jaw. The articular eminence of the temporal bone is not yet formed, and the cavity is not larger than the condyle; therefore the centre of motion in such must be in the condyle. In old people who have lost their teeth the centre of motion appears to be in the condyles, and the motion of their jaw to be only depression and elevation. They never depress the jaw sufficiently to bring the condyle forwards on the eminence, because in them the mouth is sufficiently opened when the jaw is in its natural position.

Hence it is that in old people the gums of the two jaws do not meet in the fore part of the mouth, and they cannot bite at that

part so well as at the side of the jaw; and, instead of the grinding motion, which would be useless where there are no grinders, they bruise their food rather by a simple motion of the jaw upwards and downwards.

It is from the want of teeth in both these ages that the face is shorter in proportion to its breadth. In an old person, after the teeth are gone the face is shorter while the mouth is shut by almost the whole lengths of the teeth in both jaws; that is, about an inch and a half.

From the want of teeth, too, at both those ages, the cavity of the mouth is then smaller, and the tongue seems too large and unmanageable, more especially in old people. In these last we observe also that the chin projects forwards in proportion as the mouth is shut, because the basis of the lower jaw (which is all that now remains,) describes a wider circle than the alveolar process in younger people. The jaws do not project so much forwards in a child as in an adult; hence the face is flatter, especially at the lower part. In proportion as the last grinders are produced, the sides of the curve formed by the jaws become longer, and push forward the fore part, none of the additional part passing backwards. The fore part also continues nearly of the same size, so that the whole jaw is longer in proportion to its breadth, and projects further forwards.

Of the Formation of the Alveolar Processes.

Having considered the alveolar processes in their adult, or perfect state, we shall next examine and trace them from their beginning.

We may observe the beginning of the alveolar process at a very early period. In a fœtus of three or four months it is only a longitudinal groove, deeper and narrower forwards, and becoming gradually more shallow and wider backwards: instead of bony partitions, dividing that groove into a number of sockets, there are only slight ridges across the bottom and sides, with intermediate depressions, which mark the situation of the future alveoli.

In the lower jaw the vessels and nerves run along the bottom of this alveolar cavity in a slight groove, which afterwards becomes a complete and distinct bony canal.

The alveolar process grows with the teeth, and for some time keeps the start of them. The ridges which are to make the partitions shoot from the sides across the canal, at the mouth of the cell, forming hollow arches: this change happens first at the anterior part of the jaws. As each cell becomes deeper, its mouth also grows narrower, and at length is almost, but not quite, closed over the contained tooth.

The disposition for contracting the mouth of the cell is chiefly in the outer plate of the bone, which occasions the contracted orifices of the cells to be nearer the inner edge of the jaw. The reason,

perhaps, why the bone shoots over, and almost covers the tooth, is that the gum may be firmly supported before the teeth have come through.

The alveoli which belong to the adult grinders are formed in another manner; in the lower jaw they would seem to be the remains of the root of the coronoid process, for the cells are formed for those teeth in the root of that process; and in proportion as the body of the bone, and the cells already formed, push forwards from under that process, the succeeding cells and their teeth are formed, and pushed forward in the same manner.

In the upper jaw there are cells formed in the tubercles for the young grinders, which at first are very shallow, and become deeper and deeper as the teeth grow; and they grow somewhat faster, so as almost to inclose the whole tooth before it is ready to push its way through that inclosure and gum.* There is a succession of these till the whole three grinders are formed.

Of the Formation of the Teeth in the Fœtus.

The depressions or first rudiments of the alveoli observable in a fœtus of three or four months, are filled with four or five little pulpy substances, which are not very distinct at this age. About the fifth month both the processes themselves and the pulpy substances become more distinct, the anterior of which are the most complete. About this age, too, the ossifications begin on the edge of the first incisores. The cuspidati are not in the same circular line with the rest, but somewhat on the outside, making a projection there at this age, there not being sufficient room for them.

About the sixth or seventh month the edges or tips of all these five substances have begun to ossify, and the first of them is a little advanced; and besides these, the pulp of the sixth tooth has begun to be formed: it is situated in the tubercle of the upper jaw, and under and on the inside of the coronoid process in the lower jaw. So that at this age, in both jaws, there are in all twenty teeth which have begun to ossify, and the stamina of twenty-four. They may be divided into the incisores, cuspidati, and molares, for at this age there are no bicuspides, the two last teeth on each side of both jaws having all the characteristics and answering all the purposes of the true molares in the adult, though when these first molares fall out their places are taken by the bicuspides.

The teeth gradually advance in the ossification, and about the seventh, eighth, or ninth month after birth, the incisores begin to cut or pass through the gums, first, generally, in the lower jaw. Before this time the ossifications in the third grinder, or that which makes the first in the adult, have begun.

The cuspidati and molares of the fœtus are not formed so fast as the incisores; they generally all appear nearly about the same

* Pl. IV. f. 1.

time, viz. about the twentieth or twenty-fourth month; however, the first grinder is often more advanced within the socket than the cuspidatus, and most commonly appears before it.

These twenty are the only teeth that are of use to the child from the seventh, eighth, or ninth month, till the twelfth or fourteenth year. These are called the temporary, or milk teeth, because they are all shed between the years of seven and fourteen, and are supplied by others.

Of the Cause of Pain in Dentition.

These twenty teeth in cutting the gum give pain, and produce many other symptoms which often prove fatal to children in dentition. It has been generally supposed that these symptoms arise from the tooth's pressing upon the inside of the gum, and working its way mechanically; but the following observations seem to be nearer the truth.

The teeth, when they begin to press against the gum, irritate it, and commonly give pain. The gums are then affected with heat, swelling, redness, and the other symptoms of inflammation. The gum is not cut through by simple or mechanical pressure, but the irritation and consequent inflammation produces a thinning or wasting of the gum at this part; for it often happens, that when an extraneous or a dead substance is contained in the body, it produces a destruction of the part between it and that part of the skin which is nearest it, and seldom of the other parts, excepting those between it and the surface of a cavity opening externally, and that by no means so frequently; and in those cases there is an absorption of the solids, or of the part destroyed, not a melting down or solution of them into pus. The teeth are to be looked upon as extraneous bodies with respect to the gum, and as such they irritate the inside of that part in the same manner as the pus of an abscess, an exfoliation of a bone, or any other extraneous body, and therefore produce the same symptoms, excepting only the formation of matter. If, therefore, these symptoms attend the cutting of the teeth, there can be no doubt of the propriety of opening the way for them; nor is it ever, as far as I have observed, attended with any dangerous consequence.*

* [There can indeed be no doubt that the emancipation of the rising tooth is occasioned by absorption of the gum, but it is also probable that this absorption is increased, if not wholly produced, by the pressure of its edge on the horizontal surface of the tooth. It appears probable, therefore, that when, in consequence of the rapid elongation of the root, the crown of the tooth rises faster than this process for the removal of the containing parts goes on, an undue pressure takes place on the inside of the gum, and local inflammation, accompanied by much constitutional disturbance, is the result. The mere existence of the tooth in contact with the gum "as an extraneous body," would not account for all this disturbance, for after the gums are lanced the tooth is still in contact with the soft parts; but because the pressure is thus taken off, the irritation immediately subsides.]

Of the Formation and Progress of the Adult Teeth.

Having now considered the first formation and the progress of the temporary teeth, we shall next describe the formation of those teeth which are to serve through life.

In this inquiry, to avoid confusion, I shall confine the description to the teeth in the lower jaw, for the only difference between those in the two jaws is in the time of their appearance, and generally it is later in the upper jaw. Their formation and appearance proceed not regularly from the first incisor backwards to the dens sapientiæ, but begin at two points on each side of both jaws, viz. at the first incisor and at the first molaris. The teeth between these two points make a quicker progress than those behind.

The pulps of the first adult incisor and of the first adult molaris begin to appear in a fœtus of seven or eight months; and five or six months after birth the ossification begins in them. Soon after birth the pulps of the second incisor and cuspidatus begin to be formed, and about eight or nine months afterwards they begin to ossify. About the fifth or sixth year the first bicuspis appears; about the sixth or seventh, the second bicuspis and the second molaris; and about the twelfth, the third molaris, or dens sapientiæ.

The first five may be called the permanent teeth: they differ from the temporary in having larger fangs. The permanent incisores and cuspidati are much thicker and broader; and the molares are succeeded by bicuspides, which are smaller, and have but one fang.

All these permanent or succeeding teeth are formed in distinct alveoli of their own, so that they do not fill up the old sockets of the temporary teeth, but have their new alveoli formed as the old ones decay.*

The first incisor is placed on the inside of the root of the corresponding temporary tooth, and deeper in the jaw. The second incisor and the cuspidatus begin to be formed on the inside, and somewhat under the temporary second incisor and cuspidatus. These three are all situated much in the same manner with respect to the first set, but as they are larger they are placed somewhat further back in the circle of the jaw.

The first bicuspis is placed under, and somewhat further back than the first temporary grinder, or fourth tooth of the child.

The second bicuspis is placed immediately under the second temporary grinder.

The second molaris is situated in the lengthening tubercle in the upper jaw, and directly under the coronoid process in the lower.

The third molaris, or dens sapientiæ, begins to form immediately under the coronoid process.

The first adult molaris comes to perfection and cuts the gum about the twelfth year of age, the second about the eighteenth, and

* Pl. IV. f. 1, 2, 3.

the third, or dens sapientiæ, from the twentieth to the thirtieth; so that the incisores and cuspidati require about six or seven years from their first appearance to come to perfection, the bicuspides about seven or eight, and the molares about twelve.

It sometimes happens that a third set of teeth appears in very old people; when this does happen it is in a very irregular manner, sometimes only one, at other times more, and now and then a complete set comes in both jaws. I never saw an instance of this kind but once, and there two fore teeth shot up in the lower jaw.

I should suppose that a new alveolar process must be also formed in such cases, in the same manner as in the production of the first and second sets of teeth. From what I can learn, the age at which this happens is generally about seventy. From this circumstance, and another that sometimes happens to women at this age, it would appear that there is some effort in nature to renew the body at that period.

When this set of teeth which happens so late in life is not complete, especially where they come in one jaw and not in the other, they are rather hurtful than useful, for in that case we are obliged to pull them out, as they only wound the opposite gum.*

* [This account of the manner in which the permanent teeth are formed is exceedingly imperfect. The observations of Dr. Blake, (recorded first in his inaugural thesis, and afterwards published in English in an enlarged form,) first made known the process by which this extraordinary formation is produced. Subsequent investigations have confirmed the general views given by Blake, and I make no apology for offering the following account of the process, which is substantially the same as I have already given in another work.

The formation of the permanent teeth, although essentially proceeding upon the same general principle, and produced by means of similar structures as those by which the temporary ones are formed, differs in some very remarkable points from that process. The rudiments of the permanent teeth, instead of being original and independent, like those of the temporary, are, in fact, derived from them, and remain for a considerable time attached to and intimately connected with them. (See Pl. V. f. 9, 10, 11, 12.)

At an early period in the formation of the temporary teeth, by a process which reminds us of the gemmiparous reproduction in the lower grades, both of animal and vegetable life, the investing sac, or capsule, gives off a small process, a bud containing a portion of the essential rudiments, namely, the pulp, covered by its proper membrane. This constitutes the rudiment of the permanent tooth. It commences in a small thickening on one side of the parent sac, which gradually becomes more and more circumscribed, and at length assumes a distinct form, though still connected with it by a peduncle, which is nothing more than a process of the investing sac. For a time the new rudiment is contained within the same alveolus with its parent, which is excavated by the absorbents for its reception, by a process almost unparalleled in the phenomena of physiology. It is not produced by the pressure of the new rudiment, as has been erroneously believed, but commences in the cancelli of the bone immediately within its smooth surface, thus constituting what may be termed a process of anticipation. The new cell, after being sufficiently excavated, and as the rudiment continues to increase, is gradually separated from the former one, by being more and more deeply excavated in the substance of the bone, and also by the deposition of a bony partition between them; and at length the new rudiment is shut up in its proper socket, though still connected with the temporary tooth by the cord or

The Manner in which a Tooth is formed.

The body of the tooth is formed first, afterwards the enamel and fangs are added to it. All the teeth are produced from a kind of pulpy substance, which is pretty firm in its texture, transparent, excepting at the surface, where it adheres to the jaw, and has at first the shape of the bodies of the teeth which are to be formed from it.* These pulpy substances are very vascular: they adhere only at one part to the jaw, viz. at the bottom of the cavity which is to form the socket, and at that place their vessels enter, so that they are prominent and somewhat loose in the bony cavity which lodges them.

They grow nearly as large as the body of the tooth before the ossification begins, and increase a little for some time after the ossification has begun. They are surrounded by a membrane, which is not connected with them, excepting at their root or surface of adhesion. This membrane adheres by its outer surface all around the bony cavity in the jaw, and also to the gum where it covers the alveoli.

When the pulp is very young, as in the fœtus of six or seven months, this membrane itself is pretty thick and gelatinous.† We can examine it best in a new-born child, and we find it made up of two lamellæ, an external and internal: the external is soft and spongy, without any vessels; the other is much firmer and extremely vascular, its vessels coming from those that are going to the pulp of the tooth: it makes a kind of capsule for the pulp and body of the tooth. While the tooth is within the gum there is always a mucilaginous fluid, like the synovia in the joints, between this membrane and the pulp of the tooth.

When the tooth cuts the gum, this membrane likewise is perforated, after which it begins to waste, and is entirely gone by the

process of the capsule already described, which has in the mean time been gradually attenuated and elongated.

The situation of each permanent rudiment when its corresponding temporary tooth has made its appearance through the gum, is beneath and a little behind the latter, and rather further from the centre of the jaw. From the preceding statement, then, it will be readily understood that the upper part of the new sac being, by means of the cord, connected with the gum, assumes, by and by, the same relation to that substance as that which the temporary rudiment, as before described, had orignally sustained; whilst, from its substance being deeply imbedded in the jaw, the vessels and nerves which had entered into the composition of the new process of pulp in its first production, probably became so enlarged and modified in their structure as ultimately to form the true dental branches. This is much more probable than to suppose that a new set of nerves and vessels is given off from the maxillary branches to join the pulps at a distance, through an intervening layer of bone of an indefinite thickness, to supply every new tooth.

We now, therefore, find the new rudiment in a state nearly analogous to that in which the parent tooth was originally placed, and with similar relations to the surrounding parts; the sac above, attached to the gum, and the pulp beneath, (covered with its proper membrane,) connected by its vessels, &c. with the jaws.]

* Pl. V. f. 4, 5, 6. † Pl. V. f. 1, 2.

time the tooth is fully formed, for the lower part of the membrane continues to adhere to the neck of the tooth, which has now risen as high as the edge of the gum.*

Of the Ossification of a Tooth upon the Pulp.

The beginning of the ossification upon the pulp is by one point, or more, according to the kind of tooth. In the incisores it is generally by three points, the middle one being the highest, and the first that begins to ossify. The cuspidatus begins by one point only; the bicuspis by two, one external, which is the first and the highest, and the other internal. The molares, either in a child or an adult, begin by four or five ossifications, one on each point, the external always the first. Where the teeth begin to ossify at one point only, that ossification gradually advances till the tooth is entirely completed; but if there is more than one point of ossification, each ossification increases till their bases come in contact with one another, and there all unite into one, after which they advance in growth as one ossification.

The ossifications in their progress become thicker and thicker where they first began, but increase faster on the edges of the teeth; so as thence to become more and more hollow, and the cavity becomes deeper.† As the ossification advances, it gradually surrounds the pulp till the whole is covered by bone, excepting the under surface; and while the ossifications advance, that part of the pulp which is covered by bone is always more vascular than the part which is not yet covered.‡

The adhesion of the pulp to the new-formed tooth or bone is very slight, for it can always be separated from it without any apparent violence, nor are there any vessels going from the one to the other; the place, however, where it is most strongly attached is round the

* [The statement that the bone of a tooth is produced from the pulp is erroneous. This substance constitutes only the mould upon which the ossification is formed, between which and the pulp is placed a membrane of extreme tenuity, which I have termed the proper membrane of the pulp. It is slightly attached to the surface of the pulp, which it completely covers, and it is from the outer surface of this membrane that the bone is secreted. As the pulp recedes on the deposit of the successive laminæ of bone, the ossific membrane continues to cover it, and ultimately forms the well-known membrane lining the internal cavity of the perfect tooth.

The double investing membrane or sac which surrounds the whole rudiment as far as the neck of the tooth, and no further, has been proved, by repeated injections, to be vascular throughout, though Hunter states the internal, and Blake the external layer to be exclusively so. It is from the inner surface of this capsule that the enamel is secreted, as will be more particularly noticed hereafter. As soon as the enamel is secreted the capsule becomes absorbed, beginning at the edge or horizontal surface of the tooth, where the enamel is first deposited. It is, therefore, not perforated by the rising of the tooth, as inferred in the text, but absorbed as soon as it has performed its single function.]

† Pl. V. f. 14, *a*, *b*, *c*, *d*, two rows of incisors sawed down the middle, the highest of the child, the other of the adult: *e*, *f*, *g*, two rows of grinders showing the same circumstances. ‡ Pl. V. f. 5, 6.

edge of the bony part, which is the last part formed. When the bone has covered all the pulp, it begins to contract a little and becomes somewhat rounded, making that part of the tooth which is called the neck; and from this place the fangs begin.* When the fangs form, they push up the bodies of the teeth through the sockets, which waste, and afterwards through the gum, which also wastes, as has been explained upon the cutting of the teeth; for before this time the rising of the teeth is scarce observable, as the pulp was at first nearly of the size of the body of the tooth itself, and wasted nearly in proportion to the increase of the whole ossification.

The pulp has originally no process answering to the fang;† but as the cavity of the body of the tooth is filled up by the ossification, the pulp is lengthened into a fang. The fang grows in length and rises higher and higher into the socket till the whole body of the tooth is pushed out. The socket at the same time contracts at its bottom, and grasping the neck or beginning fang, adheres to it and rises with it, which contraction is continued through the whole length of the socket as the fang rises; or the socket which contained the body of the tooth, being too large for the fang, is wasted or absorbed into the constitution, and a new alveolar portion is raised with the fang; whence in reality the fang does not sink or descend into the jaw. Both in the body and in the fang of a growing tooth, the extreme edge of the ossification is so thin, transparent, and flexible, that it would appear rather to be horny than bony, very much like the mouth or edge of the shell of a snail when it is growing; and indeed it would seem to grow much in the same manner,‡ and the ossified part of a tooth would seem to have much the same connexion with the pulp as a snail has with its shell.

As the tooth grows, its cavity becomes gradually smaller, especially towards the point of the fang. In tracing the formation of the fang of a tooth we hitherto have been supposing it to be single, but where there are two or more it is somewhat different and more complicated.

When the body of a molaris is formed, there is but one general cavity in the body of the tooth, from the brim of which the ossification is to shoot, so as to form two or three fangs.§ If two only, then the opposite parts of the brim of the cavity of the tooth shoot across where the pulp adheres to the jaw, meet in the middle, and thereby divide the mouth of the cavity into two openings;‖ and from the edges of these two openings the two fangs grow.¶

We often find that a distinct ossification begins in the middle of the general cavity upon the root of the pulp, and two processes coming from the opposite edges of the bony shell join it; which answers the same purpose.

When there are three frangs, we see three processes coming from

* Pl. V. f. 13, 14, 15.
† Pl. V. f. 1, 4, 5, 6.
‡ Pl. V. f. 13, 14, 15.
§ Pl. V. f. 13, A, A.
‖ Pl. V. f. 13, B.
¶ Pl. V. f. 13, C, D.

so many points of the brim of the cavity, which meet in the centre and divide the whole into three openings;* and from these are formed the three fangs.† We often find the fangs forked at their points, especially in the bicuspides. In this case the sides of the fang as it grows come close together in the middle, making a longitudinal groove on the outside; and this union of the opposite sides divides the mouth of the growing fang into two orifices, from which the two points are formed.

By the observations which I have made in unravelling the texture of the teeth when softened by an acid, and from observing the disposition of the red parts in the tooth of growing animals interruptedly fed with madder, I find that the bony part of a tooth is formed of lamellæ placed one within another. The outer lamella is the first formed and is the shortest; the more internal lamellæ lengthen gradually towards the fang, by which means, in proportion as the tooth grows longer, its cavity grows smaller, and its sides grow thicker.‡

How the earthy and animal substance of the tooth is deposited on the surface of the pulp is not perhaps to be explained.§

Of the Formation of the Enamel.

In speaking of the enamel we postponed treating of its formation till it could be more clearly understood; and now we shall previously describe some parts which we apprehend to be subservient to its formation, much in the same manner as the pulp is to the body of the tooth.

From its situation and from the manner in which the teeth grow, one would imagine that the enamel is first formed; but the bony part begins first, and very soon after the enamel is formed upon it. There is another pulpy substance opposite to that which we have described: it adheres to the inside of the capsule, where the gum is joined to it, and its opposite surface lies in contact with the basis of the above-described pulp, and afterwards with the new-formed basis of the tooth. Whatever eminences or cavities the one has, the other has the same, but reversed, so that they are moulded exactly to each other.

In the incisores it lies in contact, not with the sharper cutting edge of the pulp or tooth, but against the hollowed inside of the tooth; and in the molares it is placed directly against their base, like a tooth of the opposite jaw. It is thinner than the other pulp, and decreases in proportion as the teeth advance. It does not seem to be very vascular. The best time for examining it is in a fœtus of seven or eight months old.

In the graminivorous animal, such as the horse, cow, &c., whose teeth have the enamel intermixed with the bony part,‖ and whose teeth, when forming, have as many interstices as there are con-

* Pl. V. f. 13, F, G. † Pl. V. f. 13, H, I, K. ‡ Pl. V. f. 7, 8.
§ This is explained in the note to the preceding section.
‖ Pl. III. f. 20, 21.

tinuations of the enamel, we find processes from the pulp passing down into those interstices as far as the pulp which the tooth is formed from, and there coming into contact with it.

After the points of the first-described pulp have begun to ossify, a thin covering of enamel is spread over them, which increases in thickness till some time before the tooth begins to cut the gum.

The enamel appears to be secreted from the pulp above described, and perhaps from the capsule which incloses the body of the tooth. That it is from the pulp and capsule seems evident in the horse, ass, ox, sheep, &c., therefore we have little reason to doubt of it in the human species. It is a calcareous earth, probably dissolved in the juices of our body, and thrown out from these parts, which act here as a gland. After it is secreted, the earth is attracted by the bony part of the tooth which is already formed, and upon that surface it crystallizes.

The operation is similar to the formation of the shell of the egg, the stone in the kidneys and bladder, and the gall stone. This account for the striated crystallized appearance which the enamel has when broken, and also for the direction of these striæ.*

The enamel is thicker at the points and basis than at the neck of the teeth, which may be easily accounted for from its manner of formation; for if we suppose it to be always secreting, and laid equally over the whole surface, as the tooth grows, the first formed will be the thickest; and the neck of the tooth, which is the last-formed part inclosed in this capsule, must have the thinnest coat; and the fang, where the periosteum adheres, and leaves no vacant space, will have none of the enamel.

At its first formation it is not very hard; for by exposing a very young tooth to the air the enamel cracks and looks rough; but by the time that the teeth cut the gum, the enamel seems to be as hard as ever it is afterwards; so that the air seems to have no effect in hardening it.†

* The author has made many experiments on the formation of different calculi, and finds they are formed by crystallization, which were communicated to his brother, and taught by him to his pupils in 1761, and which he proposes to give to the public as soon as his time will permit.

† [According to the most accurate observations which I have been able to make, and they are confirmed by those of others, the substance which Hunter terms "another pulpy substance," adhering to the inside of the capsule, is nothing more than a thickened and turgid state of the inner layer of the capsule itself, surcharged with blood and probably also with the earthy matter which it is about to deposit, constituting the future enamel-covering of the crown of the tooth. This thickening appears to be somewhat analogous to that extraordinary turgescence which is observable in the mantle of certain species of snail, as our own *Helix Pomatia* immediately before the calcareous winter operculum is poured out from every part of its surface.

The enamel when just deposited is not much more solid than thick cream. It soon sets, but is at first but little coherent, being easily pulverised; it gradually, however, assumes its crystalline form, becomes semitransparent, and extremely hard.]

Of the Manner of Shedding the Teeth.

An opinion has commonly prevailed that the first set of teeth is pushed out by the second; this, however, is very far from being the case; and were it so, it would be attended with a very obvious inconvenience; for, were a tooth pushed out by one underneath, that tooth must rise in proportion to the growth of the succeeding one, and stand in the same proportion above the rest. But this circumstance never happens, neither can it, for the succeeding teeth are formed in new and distinct sockets, and generally the incisores and the cuspidati of the second set are situated on the inside of the corresponding teeth of the first set;* and we find that in proportion to the growth of the succeeding teeth, the fangs of the first set decay, till the whole of the fang is so far destroyed that nothing remains but the neck, or that part of the fang to which the gum adheres,† and then the least force pushes the tooth out. It would he very natural to suppose that this was owing to a constant pressure from the rising teeth against the fangs or sockets of the first set, but it is not so; for the new alveoli rise with the new teeth, and the old alveoli decay in proportion as the fangs of the old teeth decay, and when the first set falls out, the succeeding teeth are so far from having destroyed, by their pressure, the parts against which they might be supposed to push, that they are still inclosed and covered by a complete bony socket. From this we see that the change is not produced by a mechanical pressure, but it is a particular process in the animal economy.

I have seen two or three jaws where the second temporary grinders were shedding in the common way, without any tooth underneath; and in one jaw, where both the grinders were shedding, I met with the same circumstance.

A remarkable instance of this sort occurred to me in a lady who desired me to look at a loose tooth, which I found was the last temporary tooth not yet shed. I desired that it might be drawn out, and told her it was of no use and could not by any art be fixed, as it was one of the teeth that is naturally shed, and that another might come in its place: however, she was disappointed.

These cases prove evidently, that in shedding, the first teeth are not pushed out by the second set, but that they grow loose and fall out of their own accord. That the succeeding teeth have some influence on the shedding of the temporary set is proved by those very cases; since in one of the first mentioned the person was above twenty years of age, and in the other the lady was thirty; and it is reasonable to believe, that the shedding of these teeth was so late in those instances from the want of influence, whatever it is, of the new teeth. When the incisores and cuspidati of the new set are a little advanced, but long before they appear

* Pl. VI. f. 2, 3.

† Pl. V. f. 16, 17, and 18, which show the gradual decay in the single and double teeth, and also in one grinder of a horse.

through their bony sockets, there are small holes leading to them on the inside, or behind the temporary sockets and teeth; and these holes grow larger and larger, till at last the body of the tooth passes quite through them.*

Of the Growth of the Two Jaws.

As a knowledge of the manner in which the two jaws grow will lead to the better understanding of the shedding of the teeth, and as the jaws seem to differ, in their manner of growing, from other bones, and also vary according to age, it will be here proper to give some account of their growth.

In a fœtus three or four months old, we have described the marks of four or five teeth, which occupy the whole length of the upper jaw, and all that part of the lower which lies before the coronoid process, for the fifth tooth is somewhat under that process.

These five marks become larger, and the jaw-bones of course increase in all directions, but more considerably backwards; for in a fœtus of seven or eight months the marks of six teeth in each side of both jaws are to be observed, and the sixth seems to be in the place where the fifth was; so that in these last four months the jaw has grown in all directions in proportion to the increased size of the teeth, and besides has lengthened itself at its posterior end as much as the whole breadth of the socket of that sixth tooth.

The jaw still increases in all points till twelve months after birth, when the bodies of all the six teeth are pretty well formed; but it never after increases in length between the symphisis and the sixth tooth; and from this time, too, the alveolar process, which makes the anterior part of the arches of both jaws, never becomes a section of a larger circle, whence the lower part of a child's face is flatter, or not so projecting forwards as in the adult.

After this time the jaws lengthen only at their posterior ends; so that the sixth tooth, which was under the coronoid process in the lower jaw, and in the tubercles of the upper jaw of the fœtus, is at last, viz. in the eighth or ninth year, placed before these parts; and then the seventh tooth appears in the place which the sixth occupied, with respect to the coronoid process and tubercle; and about the twelfth or fourteenth year, the eighth tooth is situated where the seventh was placed. At the age of eighteen or twenty, the eighth tooth is found before the coronoid process in the lower jaw and under, or somewhat before the tubercle in the upper jaw, which tubercle is no more than a succession of sockets for the teeth till they are completely formed.

* [In the last paragraph of the section is an additional instance of the total misunderstanding of the relation of the permanent to the temporary teeth during their formation. The holes which have been described in a former note, as the foramina through which the communicating cord passes from the permanent rudiment to the neck of the temporary tooth are here erroneously stated to be the commencement of the openings through which the permanent teeth pass in their subsequent progress. See Pl. V. 9, 10, 11, 12.]

In a young child the cavity in the temporal bone for the articulation of the jaw is nearly in a line with the gums of the upper jaw; and for this reason the condyle of the lower jaw is nearly in the same line; but afterwards, by the addition of the alveolar process and teeth, the line of the gums in the upper jaw descends considerably below the articular cavity; and for that reason the condyloid process is then lengthened in the same proportion.

In old people who have lost all their teeth, the articulation comes again into the same line with the gums of the upper jaw; but in the lower jaw, the condyles cannot be diminished again for accommodating it to the upper, so that it necessarily projects beyond the gums of the upper jaw at the fore part. When the mouth is shut, the projection of the jaw at the chin fits the two jaws to each other at that place where the grinders were situated, and where the strength of mastication lies; for if the chin was not further from the centre of motion than the gums of the upper jaw, at the fore part, the jaws, in such people as have lost all their teeth, would meet in a point at the fore part, like a pair of pincers, and be at a considerable distance behind.

The Reason for the Shedding of the Teeth.

As the shedding of the teeth is a very singular process in the animal economy, many reasons have been assigned for it; but these reasons have not carried along with them that conviction which is desired. Authors have not fully considered the appearances; which naturally explain themselves; nor have they considered the advantages necessarily arising from the size and construction of only such a number as the first set; nor have they considered fully the disadvantages that such size and construction would have, if continued when it is necessary to have a great number, which is the case with the adult.

We shall consider these advantages in a child where the shedding-teeth are all completely formed, which will be setting them in the clearest point of light; and also the disadvantages that would occur if in the adult these were not changed for another set somewhat different.

If the child had been so contrived as not to have required teeth till the time of the second set appearing, there would have been no occasion for a new set; but the jaw-bones being considerably smaller in children than in adults, and it being necessary that they should have two grinders, there is not room for incisores and cuspidati of sufficient size to serve through life; and the first-formed grinders have necessarily two small fangs, and the jaw increasing at the back part only, these two grinders would have been protruded too far forwards, and at two great a distance from the centre of motion. This variation in the size of the teeth is likewise a reason why the second set are not formed in the sockets of the first, and why the old sockets are destroyed.

These circumstances, with regard to the shedding of the teeth, contradict the notion of the second set being made broader and thicker by the resistance they meet with in pushing out the first. For were we, on a partial view of the subject, to admit the supposition, the bicuspides would effectually overturn our hypothesis, because here the second set are much smaller than the first, and yet the resistance would be greater to them than to the incisores.

From the manner in which the teeth are shed, it is evident that drawing a temporary tooth for the easier protrusion of the one underneath, will be of no great service; for in general it falls out before the other can touch it. But it is often of much more service to pull out the neighbouring or adjacent temporary tooth, for we must be convinced by what has been advanced with regard to the changes in size, that excepting the whole were to be shed at the same time, or the order of shedding, viz. from before backwards, were to be inverted, that the second set of incisores and cuspidati must be pinced in room till the grinders are also shed, and therefore we find it often of use to draw a temporary tooth that is placed further back; and it would, perhaps, be right upon the whole, always to draw at least the first grinder, and perhaps, some time after, the second grinder also.*

Of the Cavity filling up as the Teeth wear down.

A tooth very often wears down so low that its cavity would be exposed if no other alteration were produced in it. To prevent this, Nature has taken care that the bottom part of the cavity should be filled up by new matter in proportion as the surface of the teeth is worn down. This new matter may be easily known from the old, for when a tooth has been worn down almost to the neck, a spot may always be seen in the middle, which is more transparent, and at the same time of a darker colour (occasioned in some measure by the dark cavity under it), and generally softer

* [The practice here recommended, "always to draw at least the first grinder" of the temporary set, has been but too much followed by the interested or ignorant, who have readily shielded their malpractice under the authority of Hunter's name. The early extraction of any of the temporary teeth to make room for the permanent ones is rarely necessary, and it is on all accounts to be deprecated, unless the peculiar circumstances of the case imperatively call for it. But the removal of the large molar teeth of the child, in *anticipation* of a future deficiency of room, is so obviously uncalled for, and such a wanton interference with the usual process of nature, that we cannot but wonder at its being proposed as a general rule, even were there no positive evils to be apprehended from it: but this is not all; not only does the premature removal of the temporary molares endanger the perfect formation of the bicuspides which succeed them, by the forcible laceration of the connecting cord before described, but, if it take place before the permanent teeth are ready to fall into their ultimate situation, the jaw will contract as the child grows, and the second set of teeth will be forced into an irregular position, from permanent want of room. These arguments hold good against the too early removal of any of the deciduous teeth.]

than the other.* Any person may be convinced of the truth of these observations by taking two teeth of the same class, but of very different ages, one just completely formed, the other worn down almost to its neck. In the last he will observe the dark spot in the centre, and if as much is cut off from the complete tooth as has been worn off from the old one, the cavity of the young tooth will be found cut through; and on examining the other, its cavity will be found filled up below that surface. Now this observation contradicts the idea of the hole leading into the cavity of the tooth being closed up; and what is still a further proof of it, I have been able to inject vessels in the cavities of the teeth in very old people when the alveolar process has been gone, and the teeth very loose in the gum.

Old people are often found to have very good sets of teeth, only pretty much worn down. The reason of this is, that such people never had any disorder in their teeth, or alveolar processes, sufficient to occasion the falling of one tooth. For if by accident one tooth is lost, the rest will necessarily fail in some degree, even though they are sound, and likely to remain so, had not this accident happened; and this weakening cause is greater in proportion to the number that are lost. From this observation we see that the teeth support one another.†

Of the Continual Growth of the Teeth.

It has been asserted that the teeth are continully growing, and that the abrasion is sufficient to keep them always of the same length; but we find that they grow at once to their full length, and that they gradually wear down afterwards, and that there is not even the appearance of their continuing to grow. The teeth would probably project a little further out of the gum if they were not opposed by those in the opposite jaw; for in young people who had lost a tooth before the rest had come to their full length, I have seen the opposite tooth project a little beyond the rest before they were at all worn down. It may be further observed, that when a tooth is lost, the opposite one may project from the disposition of the alveolar process to rise higher, and fill up at the bottom of the sockets; and the want of that natural pressure seems to give that

* Pl. III. f. 25, 26.

† [The filling up of the internal cavity of teeth in old people here alluded to, appears to be consequent upon the loss of substance from the surface. As the superstratum of bone becomes thinner by abrasion, the membrane lining the internal cavity, from which, as I have before shown, *the bone of the tooth was originally produced*, now again resumes its ossific action, and produces a fresh layer of bony matter, which in some cases at length fills the socket, and obliterates the membrane from which it has been secreted. This is particularly the case in sailors who have lived much upon hard biscuits, a circumstance which tends greatly to accelerate this abrasion of the surface, a process perfectly and obviously analogous to that of the wearing of the teeth in graminivorous animals.]

disposition to these processes, which is best illustrated in those teeth which are formed deeper in their sockets than usual. As a proof that the teeth continue growing, it has been said that the space of a fallen tooth is almost filled up by the increased thickness of the two adjacent teeth, and the lengthening of that which is opposite. There is an evident fallacy in the case; either the observations have been made upon such jaws as above described, or the appearances have not been examined with sufficient accuracy; for when the space appears to have become narrow by the approximation of the two adjacent teeth, it is not owing to any increase of their breadth, but to their moving from that side where they are well supported to the other side, where they are not. For this reason they get an inclined direction; and I observe it extends to the several adjacent teeth in a proportionally less degree, and affects those which are behind more than those which are before the vacant space.

In the lower jaw the back teeth are not fixed perpendicularly, but all inclined forward, and the depression of the jaw increases this position; the action of the teeth, when thrown out of the perpendicular, has also a tendency to increase that oblique direction, as a pair of scissors, in cutting, pushes everything forward, or from the centre of motion; therefore this alteration, I think, is most commonly observable in the lower jaw.

And that teeth are not actually always growing in breadth, must be obvious to every person who considers, that in many people, through life, the teeth stand so wide from each other that there are considerable spaces between them, which could not be the case if they were always growing in thickness.

We might add, too, that according to the hypothesis the dens sapientiæ should grow to an enormous size backward, because there it has no check from pressure; and in people where the dens sapientiæ is wanting in one jaw, which is very common, it should grow to an uncommon length in the opposite jaw, for the same reason, but neither of these things happens.

I need hardly take notice, that when a tooth has lost its opposite it will in time become really so much longer than the rest, as the others grow shorter by abrasion; and I observe that the tooth which is opposite to the empty space becomes in time not only longer, for the above-mentioned reason, but more pointed. The apex falls into the void space, and the two sides are rubbed away against the sides of the two approaching teeth next to that space.

The manner of their formation likewise shows that teeth cannot grow beyond a certain limited size. To illustrate this I may observe, that I have often, in the dead body of adults, found the left cuspidatus of the upper jaw with its points scarcely protruding out of the alveolar process, though the tooth was completely formed, and longer than the other by the whole point, which in that other was worn away. This tooth, at its first formation, had been deeper

in the jaw than what is common; and after it had grown to the ordinary size it grew no longer, though it had not the resistance of the opposite teeth to set bounds to its increase; yet commonly in these cases the tooth continues to project further and further through the gum, though this is not owing to its growing longer, but to the socket filling up behind it, and thereby continuing to push it out by slow degrees.

Of the Sensibility of the Teeth.

The teeth would seem to be very sensible, for they appear to be subject to great pain, and are easily and quickly affected by either heat or cold.

We may presume that the bony substance itself is not capable of conveying sensations to the mind, because it is worn down in mastication, and occasionally worked upon by operators in living bodies, without giving any sensation of pain in the part itself.

In the cavity of a tooth it is well known that there is exquisite sensibility, and it is likewise believed that this is owing to the nerve in that cavity. This nerve would seem to be more sensible than nerves are in common, as we do not observe the same violent effects from any other nerve in the body being exposed either by wound or sore, as we do from the exposure of the nerve of a tooth. Perhaps the reason of the intenseness, as well as the quickness of the sense of heat and cold in the teeth, may be owing to their communicating these to the nerve sooner than any other part of the body.*

Of Supernumerary Teeth.

We often meet with supernumerary teeth, and this, as well as some other variations, happens oftener in the upper than in the lower jaw, and, I believe, always in the incisores and cuspidati. I have only met with one instance of this sort, and it was in the upper jaw of a child about nine months old: there were the bodies of two teeth, in shape like the cuspidati, placed directly behind the bodies of the two first permanent incisores, so that there were three teeth in a row, placed behind one another, viz. the temporary incisor, the body of the permanent incisor, and that supernumerary tooth. The most remarkable circumstance was, that these supernumerary teeth were inverted, their points being turned upwards, and bended by

* [That the bony substance of the teeth "is of itself capable of conveying sensation to the mind" is, notwithstanding the author's presumption to the contrary, easily proved. Whence otherwise arises that acute sensation so commonly felt when the neck of a tooth is touched with the nail or with any sharp hard instrument, or when a portion of the enamel only is broken from the surface of a tooth? In the latter case every other part of the tooth may be touched without any sensation being produced, but as soon as the instrument comes in contact with the denuded portion of the bone, a painful acute sensation is instantly perceived.]

the bone which was above them not giving way to their growth, as the alveolar process does.

It often happens that the incisores and cuspidati, in the upper jaw especially, are so irregularly placed as to give the appearance of a double row. I once saw a remarkable instance of this in a boy; the second incisor on each side was placed further back than what is common, and the cuspidatus and first incisor closer together than if the second incisor had been directly between them, so that the appearance gave an idea of a second row of teeth.

This happens only in the adult set of teeth, and is owing to there not being room in the jaw for this second set, the jaw-bone being formed with the first set of teeth, and never increasing afterwards; so that if the adult set does not pass further back, they must overlap each other, and give the appearance of a second row.*

Of the Use of the Teeth, so far as they affect the Voice.

The teeth serve principally for mastication, and that use need not be further explained.

They serve likewise a secondary or subordinate purpose, giving strength and clearness to the sound of the voice, as is evident from the alteration produced in speaking, when the teeth are lost.

This alteration, however, may not depend entirely upon the teeth, but, in some measure, on the other organs of the voice having been accustomed to them; and therefore when they are gone those other organs may be put out of their common play, and may not be able to adopt themselves so well to this new instrument. Yet I believe that habit in this case has no great effect, for those people seldom or never get the better of the defect: and young children who are shedding their teeth, and are, perhaps, without any fore teeth for half a year or more, always have that defect in their voice till the new teeth come, and as these grow the voice becomes clear again.

This use seems to be entirely in the fore teeth, for the loss of one of these makes a great alteration, and the loss of two or three grinders seems to have no sensible effect. As an argument for the use of the teeth in modifying the sound of the voice, we may observe, that the fore teeth come at a time when the child begins to articulate sounds, and at that time they are so loose in the gums that they can be of very little service in mastication.

Every defect in speech, arising from this defect of the organ, is generally attended with what we call a lisp. People who have lost all their teeth, and most old people for that reason, lose, in a great

* [The occurrence of supernumerary teeth is not at all uncommon, and they are found not as Hunter supposes, only amongst the incisores and cuspidati, but not unfrequently also near the posterior molares. When found near the front of the mouth they also resemble a small and ill-formed cuspidatus, and when near the molares the crown is broader and truncated, somewhat like the neighbouring teeth. It is almost unnecessary to add that the case of irregularity mentioned in the second paragraph is one of very frequent occurrence.]

measure, their voice. This arises partly from the loss of the fore teeth, but principally from the loss of all the teeth, and of the alveolar processes of both jaws, by which means the mouth becomes too small for the tongue, and the lips and cheeks become flaccid, insomuch that the nicer movements of these parts, in the articulation of sounds are obstructed, and thence the words and syllables are indistinctly pronounced and slurred, or run into one another.

Under what Class do the Human Teeth come.

Natural historians have been at great pains to prove, from the teeth, that man is not a carnivorous animal; but in this, as in many other things, they have not been accurate in their definitions; nor have they determined what a carnivorous animal is.

If they mean an animal that catches and kills its prey with its teeth, and eats that flesh of the prey just as it is killed, they are in the right; man is not in this sense a carnivorous animal, and therefore he has not teeth like those of a lion: and this, I presume, is what they mean.

But if their meaning were that the human teeth are not fitted for eating meat that has been caught, killed, and dressed by art, in all the various ways that the superiority of the human mind can invent, they are in the wrong. Indeed, from this confined way of thinking, it would be hard to say what the human teeth are fitted for, because, by the same reasoning, man is not a graminivorous animal, as his teeth are not fitted for pulling vegetable food, &c. They are not made like those of cows or horses, for example.

The light in which we ought to view this subject is, that man is a more perfect or complicated animal than any other, and is not made, like others, to come at his food by his teeth, but by his hands, directed by his superior ingenuity, the teeth being given only for the purpose of chewing the food in order to its more easy digestion, and they, as well as his other organs of digestion, are fitted for the conversion of both animal and vegetable substances into blood, and thence he is able to live in a much greater variety of circumstances than any other animal, and has more opportunities of exercising the faculties of his mind. He ought, therefore, to be considered as a compound, fitted equally to live upon flesh and upon vegetables.

Of the Diseases of the Teeth.

The teeth are subject to diseases as well as other parts of the body. Whatever the disorder is that affects them, it is generally attended with pain; and from this, indeed, we commonly first know that they are affected.

Pain in the teeth proceeds, I believe, in a great measure from the air coming in contact with the nerve in the cavity of the tooth, for we seldom see people affected with the tooth-ache but when the cavity is exposed to the air.

It is not easy to say by what means the cavity comes to be exposed.

The most common disease to which the teeth are subject begins with a small dark-coloured speck, generally on the side of the tooth where it is not exposed to pressure; from what cause this arises is hitherto unknown. The substance of the tooth thus discoloured gradually decays, and an opening is made into the cavity. As soon as the air is thereby admitted a considerable degree of pain arises, which is probably owing to the admission of the air, as it may be prevented by filling the cavity with lead, wax, &c. This pain is not always present; the food and other substances perhaps fill up the hole occasionally, and prevent the access of the air, and of consequence the pain, during the time they remain in it. When an opening is made into the cavity of the tooth the inside begins to decay, the cavity becomes larger, the breath at the same time often acquires a putrid *fœtor*, the bone continues to decay till it is no longer able to support the pressure of the opposite tooth; it breaks and lays the cavity open. We have not as yet found any means of preventing this disease, or of curing it; all that can be done is to fill the hole with lead, which prevents the pain and retards the decay; but after the tooth is broken this is not practicable, and for that reason it is then best to extract it.

It would be best of all to attempt the extraction of a tooth by drawing it in the direction of its axis, but that not being practicable by the instruments at present in use, which pull laterally, it is the next best to draw a tooth to that side where the alveolar process is weakest, which is the inside in the two last grinders on each side of the lower jaw, and the outside in all the others.

It generally happens in drawing a tooth that the alveolar process is broken, particularly when the grinders are extracted; but this is attended with no bad consequences, as that part of the alveolar process from which the tooth was extracted always decays.

In drawing a tooth the patient complains of a disagreeable jarring noise, which always happens when anything grates against the bones of the head.*

Of Cleaning the Teeth.

From what was said of the nature and use of the enamel, it is evident that whatever is capable of destroying it must be hurtful; therefore all acids, gritty powders, and injudicious methods of scaling the teeth are prejudicial; but simply scaling the teeth, that is clearing them of the stony concretions which frequently collect about their necks, while nothing is scraped off but that adventitious substance, is proper and useful. If not removed by art, the quan-

* [The introduction of forceps of various forms, and of simple elevators, has greatly facilitated the extaction of single-rooted teeth and stumps; but the key instrument must still be acknowledged to be the most certain instrument in many, perhaps in most, cases.]

tity of the stony matter is apt to increase and to affect the gum. This matter first begins to form on the tooth near to the gum; but not in the very angle, because the motion of the gum commonly prevents the accumulation of it at this part. I have seen it cover not only the whole tooth, but a great part of the gum: in this case there is always an accumulation of a very putrid matter, frequently considerable tenderness and ulceration of the gum, and scaling becomes absolutely necessary.*

Of Transplanting the Teeth.

From considering the almost constant variety of the size and shape of the same class of teeth in different people it would appear almost impossible to find the tooth of one person that should fit, with any degree of exactness, the socket of another; and this observation is supported, and indeed would seem to be proved, by observing the teeth in skeletons. Yet we can actually transplant a tooth from one person to another without great difficulty, Nature assisting the operation if it is done in such a way that she can assist; and the only way in which Nature can assist, with respect either to size or shape, is by having the fang of the transplanted tooth rather smaller than the socket. The socket in this case grows to the tooth. If the fang is too large, it is impossible indeed to insert it at all in that state; however, if the fang should be originally too large, it may be made less, and this seems to answer the purpose as well.

* The animal fluids, when out of the course of the general circulation, especially when they stagnate in cavities, are apt to deposit an absorbent earth, and form concretions. This earth is sometimes contained in the fluids, and is only deposited, as in the formation of the stone in the urinary passages; in some cases, perhaps, the fluids undergo a change, by which the earth is first formed, and afterwards deposited. This deposition takes place particularly in weakened parts, or where the circulation is languid, or where there are few arteries, such as about joints and tendons, as if it were intended to strengthen these parts if they should at any time give way: for if an artery, for instance, is overcome by the action of the heart, and unnaturally dilated, its coats have commonly these concretions formed everywhere in their interstices. The same thing happens also in the coats of encysted tumours, which are constantly distended, in cases of distentions of the tunica vaginalis, testis, &c. It is also apt to take place in parts which have lost their natural functions, as in the coats of the eye in cases of blindness, and in diseased lymphatic glands, &c., and where the living power is diminished in the system, as in the arteries, membranes, &c. of old people; and in some particular habits, as in those who are affected by the gout.[a]

The same sort of deposition takes place likewise where there is any substance with such properties as render it a fit basis for crystallization, as when extraneous bodies are lodged in the bladder; whence such bodies are so often found to form the nucleus of a stone. The same thing happens in the bowels of many animals, whence the nucleus of intestinal concretions, or bezoars, is commonly a nail, or some indigestible substance which had been swallowed. The crust which collects upon the teeth seems to be a crystallization of the same nature.

a [This substance consists, in a very large proportion, of earthy phosphates, combined with mucus.]

The success of this operation is founded on a disposition in all living substances to unite when brought into contact with one another, although they are of a different structure, and even although the circulation is only carried on in one of them.

This disposition is not so considerable in the more perfect or complex animals, such as quadrupeds, as it is in the more simple or imperfect, nor in old animals, as in young; for the living principle in young animals, and those of simple construction, is not so much confined to, or derived from, one part of the body; so that it continues longer in a part separated from their bodies, and even would appear to be generated in it for some time; while a part, separated from an older or more perfect animal, dies sooner, and would appear to have its life entirely dependent on the body from which it was taken.

Taking off the young spur of a cock and fixing it to his comb is an old and well known experiment.

I have also frequently taken out the testis of a cock and replaced it in his belly, where it has adhered and has been nourished; nay, I have put the testis of a cock into the belly of a hen with the same effect.*

In like manner a fresh tooth, when transplanted from one socket to another, becomes, to all appearance, a part of that body to which it is now attached as much as it was of the one from which it was taken; while a tooth which has been extracted for some time, so as to lose the whole of its life, will never become firm or fixed; the sockets will also in this case acquire the disposition to fill up, which they do not in the case of the insertion of a fresh tooth.

These appearances show that the living principle exists in the several parts of the body, independent of the influence of the brain or circulation, and that it subsists by these, or is indebted to them for its continuance; and in proportion as animals have less of brain and circulation the living power has less dependence on them, and becomes a more active principle in itself; and in many animals there is no brain nor circulation, so that this power is capable of being continued equally by all the parts themselves, such animals being nearly similar in this respct to vegetables.†

* [These experiments are related in the *Animal Œconomy*.]

† [The practice of transplanting teeth from one person to another originated, I believe, with Hunter, under whose superintendence it was frequently performed. Had the results of all these cases been known to him, it is probable that this recommendation would not have been written; there is not, I believe, a single instance of its perfect success, and there are many in which it has been followed by even fatal results. Fox, in his excellent practical work on teeth, strongly reprobates this practice, and has probably prevented much pain and disease by exposing its continual failure, its occasional injurious results, and the want of correct feeling which seems to be necessarily involved in its performance. The tooth figured by Fox as having been the subject of this operation is now in the collection of Guy's Hospital; its root is deeply eroded by absorption.]

PART II.

INTRODUCTION.

The importance of the teeth is such that they deserve our utmost attention, as well with respect to the preservation of them when in a healthy state, as to the methods of curing them when diseased. They require this attention not only for the preservation of themselves, as instruments useful to the body, but also on account of other parts with which they are connected, for diseases in the teeth are apt to produce diseases in the neighbouring parts, frequently of very serious consequences, as will evidently appear in the following treatise.

One might at first imagine that the diseases of the teeth must be very simple, and like those which take place everywhere else in the bony parts of our body; but experience shows the contrary. The teeth, being singular in their structure and some other circumstances, have diseases peculiar to themselves. These diseases, considered abstractedly, are indeed very simple; but by the relations which the teeth bear to the body in general, and to the parts with which they are immediately connected, they become extremely complicated. The diseases which may arise in consequence of those of the teeth are various, such as abscesses, carious bones, &c., many of which, although proceeding originally from the teeth, are more the object of the surgeon than of the dentist, who will find himself as much at a loss in such cases as if the abscess or carious bone were in the leg or any other distant part. All the diseases of the teeth which are common to them with the other parts of the body, should be put under the management of the physician or surgeon, but those which are peculiar to the teeth and their connexions belong properly to the dentist.

It is not my present purpose to enumerate every disease capable of producing such symptoms as may lead us to suspect the teeth, for the jaws may be affected by almost every kind of disorder. I shall therefore confine myself to the diseases of the teeth, gums, and alveolar processes; which parts, having a peculiar connexion, their diseases fall properly within the province of the dentist. I shall also purposely avoid entering into common surgery, so as not to lead the dentist beyond his depth, into matters of which (it is to be supposed) he has not acquired a competent knowledge.

In order that the reader may perfectly understand what follows, it will be necessary for him previously to consider and comprehend the anatomy and uses of every part of a tooth, as explained in my

Natural History of the Human Teeth, to which I shall be obliged frequently to refer. Without such previous study the dentist will often be at a loss to account for many of the diseases and symptoms mentioned here, and will retain many vulgar errors imbibed by conversing with ignorant people, or by reading books in which the anatomy and physiology of the teeth are treated without a sufficient knowledge of the subject.

Whichever of the connected parts be originally diseased, the teeth are commonly the greatest sufferers. None of those parts can be distempered without communicating to the teeth such morbid effects as tend to the destruction of them.*

CHAPTER I.

OF THE DISEASES OF THE TEETH, AND THE CONSEQUENCES OF THEM.

§ 1. *The Decay of the Teeth, arising from Rottenness.*

THE most common disease 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, and commonly appears at first as an opaque white spot. This is owing to the enamel's losing its regular and crystallized texture, and being reduced to a state of powder,

* [The object of the author in writing this work, as given in the introduction to the second part, was indeed worthy of himself. That the dentists of his day required such information as he professes to give them, nearly as much as those of the present, may be fairly inferred; but it also may be reasonably asked, how the unfortunate dentist who is supposed by our author not to have acquired a knowledge of common surgery, as "a matter beyond his depth," is to understand the diseases "which are peculiar to the teeth *and their connexions*;" as if abscess, ulceration, tumours, caries, necrosis, &c., are to be readily understood by the charlatan who knows nothing of the principles of common surgery, when they occur in the gums and alveolar processes; whilst, if they take place in other parts of the body, they fall within the province of the surgeon. Had Hunter endeavoured to rescue the surgical treatment of the teeth altogether from the hands of the mere mechanic, and urged the study of this not uninteresting portion of professional knowledge upon the notice of the scientific practitioner, he would have done more to raise it from its present degradation than it can ever be in the power of a less influential author to effect; and we should not now have had to deplore, in his own quaint but expressive words, that the dentist should be "at a loss to account for many of these diseases and symptoms," and "retain many vulgar errors imbibed by conversing with ignorant people."]

from the attraction of cohesion being destroyed, which produces similar effects to those of powdered crystal. When this has crumbled away, the bony part of the tooth is exposed; and when the disease has attacked this part, it generally appears like a dark brown speck. Sometimes, however, there is no change of colour, and therefore the disease is not observable till it has made a considerable hole in the tooth. The dead part is generally at first round, but not always, its particular figure depending more on the place where it begins than on any other circumstance. It is often observed on the hollow parts of the grinding surface of the molares, and there looks like a crack filled with a very black substance. In the incisores the disease usually begins pretty near the neck of the tooth, and the scooping process goes on enlarging the cavity, commonly across the same part of the tooth, which almost divides it into two. When such a diseased tooth gives way, the mischief is occasioned by its body breaking off.

When it attacks the bony part it appears first to destroy the earth; for the bone becomes softer and softer, and is at last so soft on the exterior exposed surface that it can be picked away with a pin, and when allowed to dry it cracks like dried clay.

It begins sometimes in the inside of the tooth, although but rarely. In this case the tooth becomes of a shining black, from the dark colour being seen through the remaining shell of the tooth, and no hole is found leading into the cavity.

This blackness is seldom more than a portion of the bony part decayed or mortified. However, it often happens that the remaining part of the tooth becomes simply dead, in which state it is capable of taking on a dye. As it is generally on the external surface, one might expect no great mischief would ensue; but the tendency to mortification goes deeper and deeper, till at last it arrives at the cavity of the tooth, and the mortification follows. Mortification is common to every part of the body; but in most other parts this tendency is owing in a great measure to the constitution, which being corrected, that disposition ceases; but here it is local, and as such it would appear that we have no power of resisting it. When gone thus far the decay makes a quicker progress, similar to those cases where the decay begins in the cavity; for then this disposition is given to the whole cavity of the tooth, which being a much larger surface than what the disease had before to act upon, the increase of the decay seems to be in the same proportion; at last it scoops out its inner substance, till almost nothing is left but a thin shell, which generally being broken by mastication, a smaller or larger opening is made, and the whole cavity becomes at length exposed.

The canal in the fang of the tooth is more slowly affected; the scooping process appears to stop there, for we seldom know a fang become very hollow to its point when in the form of a stump; and it sometimes appears sound, even when the body of the tooth is almost destroyed: hence I conclude that the fang of the tooth has greater living powers than the body, by which the process of the

disease is retarded; and this part appears at last only to lose its living principle, and not to take on the mortifying process above described; for which reason it remains simply a dead fang; however, it does not remain perfectly at rest.*

This is the stage in which it is called a stump. It begins now to lose its sensibility, and is seldom afterwards the cause of pain.

Thus, in appearance, it will remain sometimes for many years, but there will be more or less of a change going on; Nature will be attempting to make up the deficiency by endeavouring to increase the stump; for in many cases we find the stumps thickened and lengthened at their terminations, or small ends; but it is a process she is not equal to, therefore no advantages accrue from it. When she either fails in this process, or is in such a state as not to attempt it, then by this condition of the tooth a stimulus is given to the alveolar processes which produces a filling up of the socket from the bottom, whereby the stumps are gradually protruded. But although they are pushed out at the bottom, they seldom or never project further beyond the gum than at first; and that part of the tooth which projects seems to decay in proportion to its projection. Besides this decay at the external end of the stump, there is an absorption of the fang at the bottom, which is known by the following observation: the end of the stump, which was in the gum or jaw, becomes irregularly blunted, and often rough, and has not the appearance of the end of the fang of a sound tooth.

Such stumps are in general easily extracted, being attached often to little more than the gum, and that sometimes loosely.

Although the disease appears to be chiefly in the tooth itself, and but little to depend on external causes, yet in many cases the part which is already rotten seems to have some influence upon that which remains; for if the rotten part be perfectly removed before it has arrived at the canal of the tooth, a stop is sometimes put to the further progress of the decay, at least for a time.

However, this is not constantly so; it is oftener the contrary; but it is expedient in most cases to make this trial, as it is always right to keep a tooth clean and free from specks.

This 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 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

* [The mortification and simple death of a part are exceedingly different things. On this subject the reader is referred to the *Treatise on Inflammation.*]

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

This disease and its consequences 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 ever see any 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 proportion.

This disease has not hitherto been accounted for: if it had been always on the inside of the cavity, it might have been supposed to be owing to a deficiency of nourishment from some fault in the vascular system; but as it begins most commonly externally, in a part where the teeth in their most sound state receive little or no nourishment, we cannot refer it to that cause.

It does not arise from any external injury, or from menstrua, which have a power of dissolving part of a tooth; for anything of that kind could not act so partially: and we can observe in those teeth where the disease has not gone deep, that from the black speck externally there is a gradual decay or alteration leading to the cavity, and becoming fainter and fainter. We may therefore reasonably suppose that it is a disease arising originally in the tooth itself; because when once the shell of the tooth has given way to the cavity, the cavity itself soon becomes diseased in the same way. That the disease spreads thus rapidly over the cavity as soon as the tooth has given way does not depend simply on the exposure; for if a sound tooth be broken by accident, so as to expose the cavity, no such quick decay ensues; however, sometimes we find in those cases that exposure of the cavity will produce a decay, and even pain, similar to an original disease; and in the diseased tooth we find that the exposure has a considerable effect in hastening the progress of the disease; for if the tooth be stopped so as to prevent its exposure to external injury, its cavity will not nearly so soon become diseased. Exposure, therefore, seems at least to assist the decay.

How far a rotten tooth has the power of contaminating those next to it, I believe, is not yet completely ascertained; some cases seem to favour this idea, and many to contradict it. We frequently see two teeth rotten in places exactly opposite to each other, and as one of them began first to decay, it gives a suspicion that the last diseased was infected by that which received the first morbid impression.

On the contrary, we often see one diseased, whilst another tooth, in contact with the decayed part, remains perfectly sound.*

* [The reasoning which we find in the preceding section is not only inconclusive, but in many parts not wholly consistent with itself. Nor is it possible, with the vague notions entertained by Hunter, and even by some in the present day, who follow his words rather than his spirit respecting the peculiar character of the bony structure of these organs, to form a rational and consistent

Symptoms of Inflammation.

Few or no symptoms are produced by this disease besides the above appearances till the cavity of the tooth is exposed: however, it often happens that a tenderness, or a soreness upon touch, or other external influences, takes place long before; but when the cavity is exposed, then pain and other symptoms often begin, which are generally very considerable: however, the exposure of the cavity of a tooth does not in all cases give pain. Some teeth shall moulder wholly away without ever having any sensation.

In many cases there will be very acute pain upon the cavity being exposed, which will subside and recur again without producing any other effect; but it more frequently happens that this pain is the first symptom of inflammation, and is in most cases very considerable, more so than that arising from such an inflammation in other places. The surrounding parts sympathize commonly to a considerable extent, viz. the gums, jaw-bones, and integuments covering them; they inflame and swell so much as to affect the whole of that side of the face where the affected tooth is situated. The mouth can hardly be opened; the glands of that side of the neck often swell; there is an increase of the saliva, and the eye is almost closed, the tooth not giving way to the swelling of the soft parts within it; and for this reason the local effects of the inflammation cannot be so visible as in the soft parts.

opinion on this difficult subject. Fox appears to have made an approach towards the truth; but by assuming the absolute identity of structure in the teeth and true bones, without taking into the account their remarkable and acknowledged discrepancies, he fell into the opposite error, of expecting to find in the morbid affections of the teeth the analogue of every disease to which the more highly organized bones are liable. The opinion that decay of the teeth is communicable by contact is now fast becoming obsolete. That we often see two teeth becoming decayed "at places exactly opposite to each other," as observed by Hunter, is a matter of almost proverbial notoriety; but it is not, I believe, difficult to account for this fact, without assuming a doctrine so inconsistent with all that is known of the structure no less than of the chemical composition of these organs. As the enamel, when perfect, not only prevents the wearing away of the teeth by mastication, but also protects that part which is out of the gum from external cause of irritation and decay, whatever should tend to injure that substance and destroy the unity of its texture would be likely to occasion decay of the subjacent bony substance. When two teeth, therefore, are very strongly pressed together, either during their growth or afterwards, the crystallized structure of the enamel is frequently broken down, or at least the continuity of its texture injured, to such a degree as to admit of those external causes of inflammation and of subsequent loss of vitality which have just been alluded to. This would occur *at the point of contact*, and hence the frequency of the occurrence of this disease at that part. The prevalence of decay in contiguous teeth may also be accounted for by attributing it in both to the same general exciting cause, as cold, mechanical injury, &c. And, on the other hand, it appears impossible to imagine *infection* taking place through a substance so entirely inorganic, so dense, and so perfect and uniform in its structure, as this crystallized enamel. To which it may be added, that there is no chemical agent evolved during the decay of a tooth which can decompose this substance.

Notwithstanding the absurdity of the opinion, however, it is probable that at the time when Hunter wrote the doubt expressed in the text he was the only man in the profession who ventured to entertain such a doubt.]

This inflammation of the tooth often lasts a considerable time, and then gradually subsides. We may suppose, according to the general law of inflammation, that it is at first of the adhesive kind, and accordingly we sometimes find the teeth swelled at their ends, which is a character of the adhesive stage of inflammation; and sometimes two fangs are grown together. That we seldom find adhesions between the teeth and surrounding parts may be reasonably imputed to their less aptitude for such connexions. The suppurative inflammation succeeds; but as a tooth has not that power of suppuration which leads to granulations, so as to be buried, covered up, and made part of ourselves, as happens to other bones (which would destroy any use of a tooth), the inflammation wears out, or rather the parts not being susceptible of this irritation beyond a certain time, the inflammation gradually goes off, and leaves the tooth in its original diseased state. No permanent cure, therefore, can possibly be effected by such inflammations; but the part being left in the same state as before, they are still subject to repetitions of inflammation till some change takes place, preventing future attacks, which I believe is generally, if not always, affected by the destruction of those parts which are the seat of it, viz. the soft parts within the tooth.

Nature seems in some measure to have considered the teeth as aliens, only giving them nourishment while sound and fit for service, but not allowing them when diseased the common benefits of that society in which they are placed. They cannot exfoliate, as no operations go on in them except growth; therefore, if any part is dead, the living has not the power of throwing it off, and forming an external surface capable of supporting itself, like the other parts of the body: indeed, if they had such a power no good purpose could be answered by it; for a piece of tooth simply dead is almost as useful as if the whole was living; which may be observed every day.

The pain, however, appears to take its rise from the tooth as a centre. That it should be more severe than what is generally produced by similar inflammations in other parts of the body, may, perhaps, be accounted for when we consider that these parts do not readily yield; as is likewise the case in whitloes.

It sometimes happens that the mind is not directed to the real seat of the disease, the sensation of pain not seeming to be in the diseased tooth, but in some neighbouring tooth which is perfectly sound. This has often misled operators, and the sympathizing tooth has fallen a sacrifice to their ignorance.

In all cases of diseased teeth the pain is brought on by circumstances unconnected with the disease; as, for instance, cold, wherefore they are more troublesome commonly in winter than in summer. Extraneous matter entering the cavity, and touching the nerve and vessels, will also bring on the pain.

This pain is frequently observed to be periodical; sometimes there being a perfect intermission, sometimes only an abatement of it.

The paroxysm comes on once in twenty-four hours, and for the most part towards the evening. The bark has therefore been tried; but that failing, the disorder has been suspected to be of the rheumatic kind, and treated accordingly with no better success. At length, after a more particular examination of the teeth, one of them has been suspected to be unsound; and, being extracted, has put an end to the disorder. This shows how injudicious it is to give medicines in such cases, while the true state of the tooth is unknown.

This disease is often the cause of bad breath, more so than any other disease of those parts, especially when it has exposed the cavity of the tooth. This most probably arises from the rotten part of the tooth and the juices of the mouth and food all stagnating in this hollow part, which is warm, and hastens putrefaction in them.

I come now to the prevention and cure of this disease.

The first thing to be considered is the cure of the decaying state of the tooth, or rather the means of preventing the further progress of the decay; and more especially before it has reached the cavity, whereby the tooth may be in some degree preserved, the consequent pain and inflammations, commonly called tooth-ache, avoided, and often the consequent abscesses called gum-boils. I believe, however, that no such means of absolute prevention are as yet known. The progress of the disease, in some cases, appears to have been retarded by removing that part which is already decayed; but experience shows that there is but little dependence upon this practice. I have known cases where the black spot having been filed off and scooped entirely out, the decay has stopped for many years. This practice is supposed to prevent at least any effect that the part already rotten may have upon the sounder parts; however, if this is all the good that arises from this practice, I believe in most cases it might be as well omitted. Even if it were an effectual practice, it could not be an universal one; for it is not always in the power of the operator to remove this decayed part, either on account of its situation, or on account of its having made too great a progress before it is discovered. When it is on the basis of a grinder, or on the posterior side of its neck, it can scarcely be reached. It becomes also impracticable when the disease is still allowed to go on, and the cavity becomes exposed, so that the patient is now liable to all the consequences already described, and the tooth is making haste towards a total decay; in such a case, if the decay be not too far advanced, that is, if it be not rendered useless simply as a tooth, I would advise that it be extracted, then immediately boiled, with a view to make it perfectly clean, and also destroy any life there may be in the tooth; and then that it be restored to the socket: this will prevent any further decay of the tooth, as it is now dead, and not to be acted upon by any disease, but can only suffer chemically or mechanically.

This practice, however, I would only recommend in grinders,

where we have no other resource on account of the number of fangs, as will be more fully explained hereafter. This practice has sometimes been followed with success; and when it does succeed, it answers the same end as the burning the nerve, but with much greater certainty. If the patient will not submit to have the tooth drawn, the nerve may be burned: that this may have the desired effect, it must be done to the very point of the fang, which is not always possible. Either of the concentrated acids, such as the sulphuric, the nitric, or the muriatic, introduced as far into the fang of the tooth as possible, is capable of destroying its soft parts, which most probably are the seat of pain: a little caustic alkali will produce the same effect. But it is a difficult operation to introduce any of these substances into the root of the fang, till the decay has gone a considerable length, especially if it be a tooth of the upper jaw; for it is hardly possible to make fluids pass against their own gravity; in these cases, the common caustic is the best application, as it is a solid. The caustic should be introduced with a small dossil of lint, but even this will scarcely convey it far enough. If it be the lower jaw, the caustic need only be introduced into the hollow of the tooth, for by its becoming fluid, by the moisture of the part, it will then descend down the cavity of the fang, as will also any of the acids; but patients will often not suffer this to be done till they have endured much pain and several inflammations.

When there is no other symptom except pain in the tooth, we have many modes of treatment recommended, which can only be temporary in their effects. These act by derivation, or stimulus applied to some other part of the body. Thus, to burn the ear by hot irons has sometimes been a successful practice, and has relieved the tooth-ache.

Some stimulating medicine, as spirit of lavender, snuffed up into the nose, will often carry off the pain.

When an inflammation takes place in the surrounding parts, it often is assisted by an additional cause, as cold or fever: when the inflammation has taken place in a great degree, then it becomes more the object of another consideration; for it may be lessened like any other inflammation arising from similar causes, the pressure of an extraneous body, or exposure of an internal cavity.

If the inflammation be very great, it will be proper to take away some blood. The patient may likewise properly be advised to hold some strong vinous spirit for a considerable time in his mouth. Diluted acids, as vinegar, &c., may likewise be of use, applied in the same manner. Likewise preparations of lead would be advisable; but these might prove dangerous if they should be accidentally swallowed.

If the skin is affected, poultices, containing some of the above-mentioned substances, produce relief. The pain in many cases being often more than the patient can well bear, warm applications to the part have been recommended, such as hot brandy, to divert the mind; also spices, essential oils, &c., which last are, perhaps,

the best. A little lint or cotton soaked in laudanum is often applied with success; and laudanum ought likewise to be taken internally to procure an interval of some ease. Blisters are of service in most inflammations of these parts, whether they arise from a diseased tooth or not. They cannot be applied to the part, but they divert the pain and draw this stimulus to another part; they may be conveniently placed either behind the ear or in the nape of the neck. These last-mentioned methods can only be considered as temporary means of relief, and such as only affect the inflammation. Therefore the tooth is still exposed to future attacks of the same disease.*

* [In the foregoing passages there is much important and accurate observation evinced in the description of the symptoms either attending or succeeding inflammation in the teeth. There are, however, apparently no less than three distinct diseases confounded in this description. The first is the inflammation produced by the exposed pulp from decay of the tooth; the second, suppuration of the pulp, which often takes place independently of exposure; and the third, the inflammation and suppuration of the surrounding parts, which as frequently occur from the irritation produced by the existence of dead teeth or roots in the socket (as extraneous bodies) as from any other cause.

Many of the remarks on the treatment of these affections are replete with sound sense, and have undoubtedly laid the foundation for the best modes of practice in use since that day. A few observations of a more detailed nature may not, however, be wholly useless. When the disease termed caries, or more properly gangrene, has only just commenced under the enamel, so as only to exhibit the appearance of a brown opake mark, there can be no doubt that the entire excision of the spot will much retard the progress of decay by removing one cause of irritation to the surrounding healthy bone; but if the decay has extended to any distance from the surface, the file must be used to such an extent, in order to remove the whole of the diseased portion, as to expose a considerable part of the bone to external irritants, and consequently will hasten rather than retard the mischief.

The replacement of a decayed tooth after extraction, being first of all boiled to destroy its vitality, is recommended by Hunter only theoretically. An obvious and insurmountable objection exists to this operation, which is, that a dead extraneous body is thus forced into the alveolus, still sore from the operation, which must necessarily produce much irritation, and often suppuration, with all those severe symptoms which so often arise from dead roots, or from teeth whose connexion with the socket has been destroyed by a blow.

The burning of the nerve is deserving of no better eulogy than the operation just mentioned. Hunter himself observes, with much *naiveté*, that "it must be done to the very point of the fang, *which is not always possible.*" The truth is, that burning the pulp of a tooth even superficially, to be of service at all, must be done when the cauterizing wire is at a white heat, or it otherwise only produces inflammation, and not the instantaneous destruction of the surface; but when the small size of the instrument, the distance which it must necessarily pass before it is brought into contact with the pulp, and the time which must elapse before it is applied, are considered, the impossibility of effectually employing this remedy is obvious. The other remedies here alluded to, and indeed all other caustic applications, are generally productive of more injury than benefit, and exacerbate rather than diminish their inflammation and pain. Leeches, purgative medicines, and the local application of narcotics, or camphor, &c., will often be beneficial; but, the pulp being once exposed, the relief which these afford can be but temporary, and the only remedy to be relied upon is the extraction of the tooth.]

The Stopping of the Teeth.

If the destruction of the life of the tooth, either by drawing and restoring it again, or by the actual or potential cauteries, has not been effected, and only the cure of the inflammation has been attempted, another method of preventing inflammation is to be followed, which is to allow as little stimulus to take place as possible. The cavity of the tooth not being capable of taking the alarm like most other cavities in the body, and of course not suppurating, as has been already observed, often no more is necessary, either to prevent the inflammation from taking place altogether, or extending further, than to exclude all extraneous irritating matter; therefore the stopping up the cavity becomes, in many cases, the means of preventing future attacks of the inflammation, and often retards even the progress of the disease, that is, the further decay of the tooth, so that many people go on for years thus assisted: but it is a method which must be put in practice early, otherwise it cannot be continued long; for if the disease has done considerable damage to the inside of the tooth, so as to have weakened it much, the whole body of the tooth most probably will soon give way in mastication: therefore, under such circumstances, the patient must be cautioned not to make too free with the tooth in eating.

Gold and lead are the metals generally made use of for stopping teeth. Gold being less pliable must be used in the leaf; lead is so soft in any form as to take on any shape by a very small force.

Stuffing the hollow tooth with wax, galbanum, &c. can be but of very little service, as it is in most cases impossible to confine these substances, or preserve them from being soon worn away; however, they have their uses, as it is a practice which the patients themselves can easily put in execution.

It often happens from neglect, and much oftener in spite of all the means that can be used, that the tooth becomes so hollow as to give way, whereby the passage becomes too large to keep in any of the above-mentioned substances; however, in this case, it sometimes happens that a considerable part of the body of the tooth will still stand, and then a small hole may be drilled through this part, and after the cavity has been well stopped, a small peg may be put into the hole, so as to keep in the lead, gold, &c. But when this cannot be done, we may consider the broken tooth as entirely useless, or at least it will soon be so; and it is now open to attacks of inflammation, which the patient must either bear, or submit to have the tooth pulled out. If the first be chosen, and the repeated inflammations submitted to, a cure will be performed in time by the stump becoming totally dead; but it is better to have it pulled out, and suffer once for all.

Upon pulling out these teeth we may in general observe a pulpy substance at the root of the fang, so firmly adhering to the fang as to be pulled out with it. This is in some pretty large, so as to have made a considerable cavity at the bottom of the socket. This

substance is the first beginning of the formation of a gum-boil, as it at times inflames and suppurates.*

§ 2. *The Decay of the Teeth by Denudation.*

There is another decay of the teeth, much less common than that already described, which has a very singular appearance. It is a wasting of the substance of the tooth very different from the former. In all the instances I have seen, it has begun on the exterior surface of the tooth, pretty close to the arch of the gum. The first appearance is a want of enamel, whereby the bony part is left exposed, but neither the enamel nor the bony part alters in consistence as in the above-described decay. As this decay spreads, more and more of the bone becomes exposed, in which respect also it differs from the former decay; and hence it may be called a denuding process. The bony substance of the teeth also gives way, and the whole wasted surface has exactly the appearance as if the tooth had been filed with a rounded file, and afterwards had been finely polished. At these places the bony parts, being exposed, become brown.

I have seen instances where it appeared as if the outer surface of the bony part, which is in contact with the inner surface of the enamel, had first been lost, so that the attraction of cohesion between the two had been destroyed, and as if the enamel had been separated for want of support, for it terminated all at once.

In one case, the two first incisors had lost the whole of the enamel; on their anterior surfaces they were hollowed from side to side, as if a round file had been applied to them longitudinally, and had the finest polish imaginable. The three grinders on each side appeared as if a round file had been used on them in a contrary direction to that on the incisors, viz. across their bodies close to the gum, so that there was a groove running across their bodies,

* [The operation of filling the teeth is much better understood in the present day than it was at the time when the foregoing directions were written. Notwithstanding the numerous experiments which have been made, and the innumerable quack nostrums which have been introduced to the public with promises which from their universality ought at once to he disbelieved, there is still no method of filling teeth with success where the pulp is exposed, and no substance which for durability and comfort can be compared to pure gold. All the amalgams, pastes, cements, or fusible metallic compositions, some of them ingenious and plausible, have insuperable disadvantages. It is not meant that they may not in some few cases partially succeed where a tooth will not bear the pressure necessary to render the gold sufficiently firm and solid, but in almost all cases where these are available gold would be much more so.

In order to employ this mode of retarding or preventing the progress of decay with the greatest effect, the pulp must not have been exposed. In fact the operation should be had recourse to as soon as the enamel has given way, or even earlier, and the decayed part can be drilled out of the tooth. When it has gone still further, the decayed portion must be entirely removed by means of little instruments adapted to this purpose, and the cavity being made perfectly dry, the gold, beaten of a proper thickness, is to be carefully pressed into the cavity until it is completely and solidly filled.]

which was smooth in the highest degree. Some of the other teeth in the same jaw had begun to decay in a similar manner; also the teeth in the lower jaw were become diseased.

I saw a case very lately where the four incisors of the upper jaw had lost their enamel entirely on their anterior surfaces, and there was scarcely a tooth in the mouth which had not the appearance of having had a file applied across it close to the gum.

Those whom I have known have not been able to attribute this disease to any cause; none of them had ever done anything particular to the teeth, nor was there in appearance anything particular in the constitution which could give rise to such a disease. In the first of these cases the person was about forty; in the last about twenty years of age.

From its attacking certain teeth rather than others in the same head, and a particular part of the tooth, I suspect it to be an original disease of the tooth itself, and not to depend on accident, way of life, constitution, or any particular management of the teeth.*

§ 3. *The Swelling of the Fang.*

Another disease of the teeth is a swelling of the fang, which most probably arises from inflammation, while the body continues sound, and is of that kind which in any other bone would be called a spina ventosa.† It gives considerable pain, and nothing can be seen externally.

The pain may either be in the tooth itself or the alveolar process, as it is obliged to give way to the increase of the fang.

As a swelling of this kind does not tend to the suppurative inflammation, and as I have not been able to distinguish its symptoms from those of the nervous tooth-ache, it becomes a matter of some difficulty to the operator; for the only cure yet known is the extraction of the tooth, which has been often neglected on a supposition that the pain has been nervous.

These diseases of the teeth, arising from inflammation, become often the cause of the diseases in the alveolar processes and gums, which I shall proceed to describe.‡

* [I have elsewhere mentioned a very curious case of an affection somewhat analogous to that here described. It consisted of the gradual truncation of the edges of the front teeth, both of the upper and lower jaw, extending back to the bicuspides. The exposed surface was perfectly smooth and polished, and the loss of substance extended so far that the cavities of the teeth must have been opened, but that they had become filled with a new solid bony substance, so transparent that it was only by touching it that its presence was ascertained. As the teeth never could have come in contact at the truncated part, and as no mechanical means had ever been used by which it could have been occasioned, the cause of this singular affection remains wholly unknown.]

† [Natural History of the Teeth, p. 23.]

‡ [The affection here described is nothing more than a deposit of bony matter around the fang, produced, doubtless, by inflammation of the periosteum. The new bone is rather yellower and less opaque than the original structure. Hunter has alluded here to the occurrence of nervous pains, produced by these cases. It appears probable that the pressure of the new bone upon the nerves of the perios-

§ 4. *Gum-Boils.*

Although suppuration cannot easily take place within the cavity of a tooth, yet it often happens that the inflammation which is extended beyond it is so great as to produce suppuration in the jaw at the bottom of the socket where the diseased tooth is, forming there a small abscess, commonly called a gum-boil.

This inflammation is often very considerable, especially when the first suppuration takes place. It is often more diffused than inflammations in other parts, and affects the whole face, &c.

The matter, as in all other abscesses, makes its own way outwards, and as it cannot be evacuated through the tooth, it destroys the alveolar processes, and tumifies the gum, generally on the fore part, either pointing directly at the root of the tooth, or separating the gum from it, and is evacuated in one or other of these two ways, seldom on the inside of the gum; however, this sometimes happens.

Gum-boils seldom arise from other causes; however, it sometimes happens that they originate from a disease in the socket or jaw, having no connexion with the tooth, and only affecting it secondarily. Upon drawing such teeth, they are generally found diseased at or near the point, being there very rough and irregular, similar to ulcerating bones. There is no disease to appearance in the body of the tooth. These last-described gum-boils may arise wholly from such a cause, the appearance on the fang of the tooth being only an effect.

These abscesses, whether arising from the teeth or the sockets, always destroy the alveolar processes on that side where they open, as is very evident in the jaw-bones of many sculls; on which account the tooth becomes more or less loose. It may be perceived in the living body; for when the alveolar process is entirely destroyed on the outside of the tooth, if that tooth be moved, the motion will be observed under the gum along the whole length of the fang.

So far the teeth, alveolar processes, and gums become diseased by consent.

It is common for these abscesses to skin over, and in all appearance heal. This is peculiar to those which open through the gums; but those which discharge themselves betweem the gums and teeth can never heal up, because the gum cannot unite with the tooth; however, the discharge in them becomes less at times from a subsiding of the suppuration, which indeed is what allows the other to

teum of the alveolus, or of the alveolar process itself, is the cause of this pain, for it cannot be distinguished from local neuralgia produced by any other similar cause. Cases of this description are detailed by Fox and by myself, in which the only method by which the true seat of pain could be ascertained was by striking the affected tooth, by which pain was produced; and the extraction of the tooth at once exhibited the cause of the pain and effected its cure.]

skin over. But either exposure to cold, or some other accidental cause, occasioning a fresh inflammation, produces an increased suppuration, which either opens the old orifice in the gum, or augments the discharge by the side of the tooth; however, I believe, the inflammation of this last case is not so violent as in the other, where a fresh ulceration is necessary for the passage of the matter.

Thus a gum-boil goes on for years, healing and opening alternately; the effect of which is that the alveolar processes are at length absorbed, and the tooth gets looser and looser, till it either drops out or is extracted.

Most probably in all such cases the communication between the cavity of the tooth and the jaw is cut off; yet it keeps in part its lateral attachments, especially when the gum grasps the tooth: but in those cases, where the matter passes between the gum and the tooth, these attachments are less; but some of them are still retained, particularly on the side opposite to the passage for the matter.

Gum-boils are easily known. Those which open through the gum may be distinguished by a small rising between the arch of the gum and the attachment of the lip; upon pressing the gum at the side of this point, some matter will commonly be observed oozing out at the eminence. This eminence seldom subsides entirely; for even when there is no discharge, and the opening is healed over, a small rising may still be perceived, which shows that the gum-boil has been there.

Those gum-boils which discharge themselves between the gum and the tooth are always discovered by pressing the gum, whereby the matter is pressed out, and is seen lying in the angle between the gum and tooth.

These abscesses happen much more frequently in the upper jaw than in the lower, and also more frequently to the cuspidati, incisores, and bicuspides in that jaw than to the molares; seldom to the fore teeth in the lower jaw.

As gum-boils are in general the consequence of rotten teeth, we find them in young and middle-aged people more frequently than in old; but they appear to be most common to the shedding teeth. This will arise from those teeth being more liable to become rotten; and perhaps there may be another reason, viz. the process of ulceration which goes on in these teeth,* in some cases falling into suppuration.

It sometimes happens in these gum-boils that a fungus will push out at the orifice, from a luxuriant disposition to form granulations in the inside of the abscess, and the want of power to heal or skin; the same thing frequently happens in issues, where the parts have a disposition to granulate, but have not the power of healing, on account of an extraneous body being kept there. The tooth in the

* Vide Natural History of the Teeth, for an explanation of this process in those teeth, p. 47.

present case acts as an extraneous body, and by the secretion of matter the abscess is prevented from healing.

In the treatment of gum-boils, the practice will be the same, whether the abscess has arisen from a diseased tooth, or a disease in the socket.

The teeth being under such circumstances in the animal machine that they cannot partake of all the benefits of a cure in the same manner as other parts do, on that account, when an abscess forms itself about the root of a tooth, the tooth, by losing its connexion with the other parts, loses every power of union, as it is not endowed with the power of granulating, and thereby it becomes an extraneous body, or at least acts here as an extraneous body, and one of the worst kind, such as it is not in the power of any operation of the machine to get rid of. This is not the case with any other part of the body, for when any other part becomes dead, the machine has the power of separating it from the living, called sloughing or exfoliation, and expelling it, whence a cure is effected; but in the case of gum-boils the only cure of them is the extraction of the tooth. As this is the last resource, everything is to be done to make the parts as easy under the disease as possible, so that this operation may be postponed.

When the abscess has opened through the gum, I believe the best method that can be tried with a view to prevent future gatherings is to prevent the closing up of the abscess; and this may be done by enlarging the opening, and keeping it enlarged till the whole internal surface of the cavity of the abscess is skinned over, or till the opening in the gum loses the disposition to close up, which will in a great measure prevent any future formation of matter, or at least whatever is formed will find an easy outlet, which will prevent these accumulations from taking place ever after. The end of the fang will indeed be hereby exposed, but under such circumstances it will not be in a worse situation than when soaked in matter.

One method of doing this is to open the gum-boils by a crucial incision, the full width of the abscess, and fill it well with lint, which should be dipped in lime-water, or a diluted solution of lunar caustic, made by dissolving one drachm of the caustic in two ounces of distilled water; and the wound should be dressed very frequently, as it is with difficulty that the dressing can be kept in. If this is not sufficient to keep the wound open, it may be touched with the lunar caustic, so as to produce a slough; and this may be repeated if it should be found necessary.

One considerable disadvantage occurs in this practice, which is the difficulty of keeping on the dressings; but constant attention will make up for the inconvenience of situation.

If the surface of the abscess be touched with the potassa fusa, and the lip kept from coming in contact with the part for one minute, it answers better than any other method; for this, within that space of time, will penetrate to the bottom.

The surface of the boil should be first wiped dry, as much as the

nature of the part will allow, to prevent as much as possible the spreading of the caustic, which by care can be prevented, as the operator will watch it the whole time.

To extract the tooth, then to file off any diseased part of it, and immediately to replace it, has been practised, but often without the desired success; for it has often happened that a tooth has been introduced into a diseased jaw. This practice, however, now and then has succeeded.

When a gum-boil is formed on a back or molar tooth, such very nice treatment is not necessary as when it happens to the fore teeth, because appearances are there of less consequence; therefore the gum may be slit down upon the fang through its whole length, from the opening of the gum-boil to its edge, which will prevent any future union; and the whole cavity of the abscess skinning over will prevent any future collection of matter. The wound appears afterwards like the hare lip, and therefore this practice is not advisable where it would be much in view, as when the disease is in the fore teeth. In these cases, where the granulations push out through the small opening, they may be cured by the method above mentioned; but if it is not complied with, they may be very safely cut off with a knife or lancet. However, this does not effect a cure, for they commonly rise again. To slit the gum in this case has been common, but it is a bad method whenever the defect is in sight.*

§ 5. *Excrescences from the Gum.*

From bad teeth there are also sometimes excrescences arising at once out of the gum, near, or in contact with, the diseased tooth.

In general they are easily extracted with a knife, or whatever cutting instrument can be best applied; but this will vary, according to their situations and the extent of their base.

They will often rise in a day or two after the operation as high as ever; but this newly generated matter generally dies soon, and the disease terminates well. They have often so much of a cancerous appearance as to deter surgeons from meddling with them; but where they arise at once from the gum, and appear to be the only diseased part, I believe they have no malignant disposition.

However, I have seen them with very broad bases, and where the whole could not be removed, and yet no bad consequences have attended their removal. These often rise again in a few years, by which means they become very troublesome.

After the extirpation of them, it is often necessary to apply the actual cautery to stop the bleeding; for arteries going to increased

* [The practical surgeon who has seen much of the diseases of the teeth will see that the long detail of the treatment of gum-boil, or, as it may with more propriety be termed, alveolar abscess, is altogether supererogatory. The roots occasioning these gum-boils *must* be removed, or every other means will fail.]

parts are themselves increased, and also become diseased, and have not the contractile power of a sound artery.*

§ 6. *Deeply seated Abscesses in the Jaws.*

Sometimes deeper abscesses occur than those commonly called gum-boils. They are often of very serious consequence, producing carious bones, &c. These commonly arise from a disease in the tooth, and more especially in the cuspidati, those teeth passing further into the jaw than the others. Their depth in the jaw being beyond the attachment of the lip to the gum, if an abscess forms at their points, it more readily makes its way through the common integuments of the face, than between the gum and lip, which disfigures the face; and when in the lower jaw looks like the evil. In the upper jaw it makes a disagreeable scar on the face, about half an inch from the nose.

These, although they may sometimes arise from diseases of the teeth and gums, yet are properly the object of common surgery; and the surgeon must apply to the dentist, if his assistance is necessary, to pull out the tooth, or to perform any other operation which comes under his province.

It sometimes happens that the abscess is situated some way from the root of the diseased tooth both in the upper jaw and the lower; but, I think, more frequently in the lower. When it threatens to open externally on the skin of the face, great care should be taken to prevent it, and an opening very early made into the swelling on the inside of the lip; for it is generally very readily felt there. This practice of early opening these abscesses on the inside of the mouth is more necessary when the abscess is in the lower jaw than when in the upper, because matter by its weight always produces ulceration more readily at the lower part. I have seen this practice answer, even when the matter had come so near the skin as to have inflamed it. If it is in the upper, the opening need not be so very large, as the matter will have a depending outlet.

To prevent a relapse of the disease, it will in most cases be necessary to pull out the tooth; which has either been the first cause, or has become diseased, in consequence of the formation of the abscess; and in either case is capable of reproducing the disease.

The mouth should be often washed; and while the water is within the mouth, the skin should be pressed opposite to the abscess.

If the life of the bone be destroyed, it will exfoliate; and very probably two or three of the teeth may come away with the exfo-

* [Whenever the tumours here described are produced by the irritation arising from diseased or dead teeth, they will constantly recur after removal, until the cause is removed by the extraction of the teeth; and it often happens that after this operation they disappear spontaneously. It is not uncommon for a tumour of this description so completely to conceal the stump that has occasioned its growth, that it is only by the excision of the tumour that the cause can be ascertained. It is therefore necessary in all cases of this description that a root should be carefully searched for after the removal of such a tumour.]

liation. Little should be done in such cases, except that the patient should keep the mouth as clean as possible by frequently washing it, and when the bones exfoliate, they should be removed as soon as possible. In these cases it is but too common for the dentist to be very busy, and perhaps do mischief through ignorance.

§ 7. *Abscess of the Antrum Maxillare.*

The antrum maxillare is very subject to inflammation and suppuration, in consequence of diseases of the neighbouring parts, and particularly of the duct leading to the nose being obliterated. Whether this is the cause, or only an effect, is not easily determined, but there is great reason to suppose it an attendant, from some of the symptoms. If it be a cause, we may suppose that the natural mucus of these cavities accumulating irritates and produces inflammation for its own exit, in the same manner as an obstruction to the passage of the tears through the lachrymal duct produces an abscess of the lachrymal sac.

This inflammation of the antrum gives a pain which will be at first taken for the tooth-ache, especially if there be a bad tooth in that side; however, in these cases, the nose is more affected than commonly in a tooth-ache.

The eye is also affected; and it is very common for people with such a disease to have a severe pain in the forehead, where the frontal sinuses are placed; but still the symptoms are not sufficient to distinguish the disease. Time must disclose the true cause of the pain; for it will commonly continue longer than that which arises from a diseased tooth, and will become more and more severe; after which a redness will be observed on the fore part of the cheek, somewhat higher than the roots of the teeth, and a hardness in the same place, which will be considerably circumscribed. This hardness may be felt rather highly situated on the inside of the lip.

As this disease has been often treated of by surgeons, I shall only make the following remarks concerning it.

The first part of the cure, as well as of that of all other abscesses, is to make an opening, but not in the part where it threatens to point: for that would generally be through the skin of the cheek.

If the disease is known early, before it has caused the destruction of the fore part of the bone, there are two ways of opening the abscess: one by perforating the partition between the antrim and the nose, which may be done; and the other by drawing the first or second grinder of that side, and perforating the partition between the root of the alveolar process and the antrum, so that the matter may be discharged for the future that way.

But if the fore part of the bone has been destroyed, an opening may be made on the inside of the lip, where the abscess most probably will be felt; but this will be more apt than the other perforation to heal, and thereby may occasion a new accumulation; which

is to be avoided, if possible, by putting in practice all the common methods of preventing openings from healing or closing up: but this practice will rather prove troublesome; therefore the drawing the tooth is to be preferred, because it is not so liable to this objection.*

CHAPTER II.

OF THE DISEASES OF THE ALVEOLAR PROCESSES, AND THE CONSEQUENCES OF THEM.

Having thus far treated of the diseases of the teeth themselves, and those of the sockets and gums, which either arise from them or are similar to such as arise from them, I come now to consider the diseases which take place primarily in the sockets, when the teeth are perfectly sound. These appear to be two; and yet I am not sure but that they are both fundamentally the same, proceeding together from the same cause, or one depending on the other.

The first effect which takes place is a wasting of the alveolar processes, which are in many people gradually absorbed and taken into the system. This wasting begins first at the edge of the socket, and gradually goes on to the root or bottom.

The gum, which is supported by the alveolar process, loses its connexion, and recedes from the body of the tooth, in proportion as the socket is lost; in consequence of which, first the neck, and then more or less of the fang itself, becomes exposed. The tooth of course becomes extremely loose, and at last drops out.

The other effect is a filling up of the socket at the bottom, whereby the tooth is gradually pushed out. As this disease seldom happens without being attended by the other, it is most probable that they generally both arise from the same cause. The second in these cases may be an effect of the first. Both combine to hasten the loss of the tooth; but it sometimes happens that they act separately; for I have seen cases where the gum was leaving the teeth

* [The true nature of this affection is generally mistaken, and the error is perpetuated by the misapplication of the term *abscess*. It consists of nothing more than an altered secretion of the mucous lining of the antrum, produced by a condition of the part perfectly analogous to that of the lining of the urethra in gonorrhœa. It does not always happen that the opening into the nose becomes impervious in this disease. Yet even where this communication remains free, and allows of a ready exit for the mucopurulent secretion, no remedies can be applied to the diseased membrane without removing a tooth for the purpose of perforating the floor of the antrum. The usual mode of effecting this is by means of a small trocar; and the treatment is similar to that of gonorrhœa, as far as relates to the injection of stimulant or astringent applications, which are not of course liable to the same objections in the present instance as in the disease just mentioned.]

and yet the tooth was not in the least protruded; on the other hand, I have seen cases where the tooth was protruding, and yet the gum kept its breadth; but where this is not the case, and the gums generally become extremely diseased; and as they are separated from both the teeth and the alveolar process, there is a very considerable discharge of matter from those detached surfaces.

Though the wasting of the alveoli at their mouths, and the filling up at their bottoms, are to be considered as diseases, when they happen early in life, yet it would appear to be only on account of a natural effect taking place too soon; for the same thing is very common in old age;* and also, as this process of filling up the bottom, and wasting of the mouths of the alveolar processes, takes place in all ages, where a tooth has been drawn, and the connexion between the two parts is destroyed, this might lead us to suspect that the original cause of these diseases may be a want of that perfect harmony which is required between the tooth and socket, whereby a stimulus may be given in some degree similar to the loss of a tooth; and by destroying that stimulus upon which the absorption of the process and the filling up of the socket depend, the natural disposition may be restored. This last opinion is strengthened by the following case.

One of the first incisores of the upper jaw of a young lady was gradually falling lower and lower. She was desirous of having a tooth transplanted, which might better fit the shallow socket, as it was now become. She consulted me: I objected to this, fearing that the same disposition might still continue; in which case the new tooth would be probably pushed out in about half a year; that the time since the old one began to sink, and a relief of so short a continuance, would be all the advantage gained by the operation; but I observed, at the same time, that the operation might have the effect of destroying the disposition to filling up, so that the new tooth might keep its ground. This idea turned the balance in favour of the operation; and it was performed. Time showed that the reasoning was just; the tooth fastened, and has kept in its situation for some years.

These diseases arise often from visible causes. Anything that occasions a considerable and long-continued inflammation in those parts, such particularly as salivation, will produce the same effect. The scurvy, also, when carried to a great height, attacks the gums and the alveolar processes, which becomes a cause of the dissolution of those parts. This is most remarkable in the scurvy at sea.

When the disease arises from these two last causes, the gums are either effected with the same disease, together with the alveolar processes, or they sympathize with them. They swell, become soft and tender, and upon the least pressure or friction bleed very freely.

How far these diseases can be prevented and cured is, I believe, not known.

* Natural History of the Teeth, p. 11.

The practice has principally been to scarify the gums freely; and this with a view to fasten the teeth made loose by the disease, which has therefore generally made a considerable progress before even an attempt towards a cure has been made. This scarification has certainly a good effect in some cases, the teeth thereby becoming much faster; but how far the alveolar processes have been destroyed in such instances cannot be determined. Perhaps only a general fulness of the attaching membrane between the tooth and the process had taken place, as in a slight salivation, so as to push the tooth a little way out of the bony socket; which having subsided by the plentiful bleeding, the tooth of course becomes fast. Or perhaps, by producing an inflammation of another kind, the first inflammation, or disposition to inflame, is destroyed; which evidently appeared in the case of the young lady above mentioned.

If the above practice is unsuccessful, and the tooth continues to protrude, it will either become very troublesome or a great deformity. A front tooth may not, indeed, be at first so troublesome as a grinder, because these teeth frequently overhang, but it will be extremely disagreeable to the eye.

If the cause cannot be removed, the effect must be the object of our attention. To file down the projecting part is the only thing that can be done; but care must be taken not to file into the cavity, otherwise pain, inflammation, and other bad consequences may probably ensue. This practice, however, will be very troublesome, because it will be difficult to file a loose tooth. At last the tooth will drop out, which will put an end to all further trouble.

If the alveoli have really been destroyed in those cases of loose teeth which have become firm again, it would be difficult to ascertain whether they have a power of renewing themselves analogous to that power by which they first grow, or whether the fastening be effected by a closing of the gum and process to the teeth. When the disease arises from the scurvy, the first attempt must be to cure that disease, and afterwards the above local treatment may be of service.

Together with drawing blood from the gums, astringents have always been used to harden them. But when the disease does not arise from a constitutional cause, which may be removed (such as the sea-scurvy or salivation), but from a disposition in the parts themselves, I have seen little relief given by them.

The tincture of myrrh, tincture of Peruvian bark, and sea-water are some of the applications which have been recommended.

In such cases I have seen considerable benefit from the use of the tincture of bark and laudanum, in the proportion of two parts of the tincture of bark to one of the laudanum: and this to be used frequently, and at each time to be kept in the mouth during ten, fifteen, or twenty minutes.*

* [The practice here recommended of filing a tooth which is descending in the alveolus, is, on more than one account, exceedingly injurious. The immediate

CHAPTER III.

OF THE DISEASES OF THE GUMS, AND THE CONSEQUENCES OF THEM.

§ 1. *The Scurvy in the Gums (vulgarly so called).*

The gums are extremely subject to diseases, the symptoms of which, in an advanced state of them, are in general such as were described in the preceding chapter.

They swell, become extremely tender, and bleed upon every occasion; which circumstances being somewhat similar to those observable in the true scurvy, the disease has generally been called a scurvy in the gums.

But as this seems to be the principal way in which the gums are affected, I suspect that the same symptoms may arise from various causes, as I have often seen the same appearances in children evidently of a scrofulous habit, and have also suspected the same cause in grown people; they likewise frequently appear in persons who are in all other respects perfectly healthy.

When the gums first begin to have a tenderness, we may observe it first on their edges; the common smooth skin of the gum is not continued to its very edge, but becomes at the edge a little rough like a border, and somewhat thickened. The part of the gum between two teeth swells, and often pushes out like luxuriant flesh, which is frequently very tender.

The inflammation is often carried so far as to make the gums ulcerate, so that the gums in many cases have a common ulcer upon them, by which process a part of the teeth is denuded. This is often on one part only, often only on one jaw, while in some cases it is on the whole gums on both jaws.

In this case it often happens that the alveolar process disappears, after the manner above described (see page 80), by taking part in the inflammation, either from the same cause, or from sympathy. In such cases there is always a very considerable discharge of matter from the inside of the gum and alveolar process, which always takes the course of the tooth for its exit.

cause of such a descent of the tooth is, as Hunter observes, a deposit of bone in the alveolus; and, as this deposit takes place in consequence of some irritation in the periosteum, everything should be avoided that could increase this irritation. Filing, however, would certainly increase it to a great degree. It would also tend greatly to lessen the attachment of the tooth to the socket, and the support which the latter affords to it. The best mode of treatment appears to be, to apply leeches occasionally, particularly when there is any unusual sensation produced by touching the tooth, indicating a degree of inflammation in the periosteum of the socket. This plan may be followed up by the use of astringent lotions. It is unnecessary to add, that any force applied to the tooth, and even frequently touching it, should be avoided. Ligatures are especially improper.]

In many of these cases we find that while the gums are ulcerating in one part, they are swelling and becoming spongy in another, and hanging loose upon the teeth; and this often takes place where there is no ulceration in any part.

The treatment proper in this disease, where the gums become luxuriant from a kind of tumefaction, is generally to cut away all the redundant swellings of the gum. I have seen several instances where this has succeeded; but still I am inclined to think that this is not the best practice; for it is not that an adventitious substance is thus removed, as in the case of luxuriant granulations from a sore, but a part of the gum itself is destroyed, in like manner as a part enlarged by inflammation may be reduced by the knife to its natural size; which would certainly be bad practice. I should suspect that the good arising from such practice is owing to the bleeding which takes place, especially as I have found from experience that simply scarifying the gums has answered the same purpose. Where there are reasons for supposing it to arise from a peculiarity in the constitution, the treatment should be such as will remove this peculiarity.

If the constitution is scorbutic, it must be treated with a view to the original disease. If scrofulous, local treatment, by wounding the parts, may do harm; but sea-bathing, and washing the mouth frequently with sea-water, are the most powerful means of cure that I know.*

§ 2. *Callous Thickenings of the Gums.*

The gums are also subject to other diseases, abstracted from their connexion with the alveoli and teeth, which do not wholly belong to our present subject.

A very common one is the thickening of the gum in some particular place, of a hard callous nature, similar to an excrescence. Many of these have a cancerous appearance, which deters the surgeon from meddling with them; but in general without reason.

They may be often removed by the knife, but not always. The bleeding which follows is generally so considerable that it is frequently necessary to apply the actual cautery.

They sometimes grow again, which subjects the patient to the same operation. I have known them extracted six times; but in such cases I suspect that they really have a cancerous disposition;

* [In the most severe cases of this disease which have ever come under the notice of the editor, after every other means had failed to produce any permanent benefit, the two remedies mentioned in the text, sea-bathing and washing the mouth with sea-water, have proved, as Hunter observes, the most powerful means of cure. It is very probable that the general tonic effect of change of air and of scene, and the absence of all the deiblitating tendencies of close application to business and of a town residence and town habits, may have greatly assisted the means alluded to; but there appears also to have been much direct benefit derived from the local application of sea-water].

at least, it has been so in two cases which have fallen under my observation.

But here the skill of the surgeon rather than that of the dentist is required.

CHAPTER IV.

OF NERVOUS PAINS IN THE JAWS.

THERE is one disease of the jaws which seems in reality to have no connexion with the teeth, but of which the teeth are generally suspected to be the cause. This deserves to be taken notice of in this place because operators have frequently been deceived by it, and even sound teeth have sometimes been extracted through an unfortunate mistake.

This pain is seated in some one part of the jaws. As simple pain demonstrates nothing, a tooth is often suspected, and is perhaps drawn out; but still the pain continues, with this difference, however, that it now seems to be in the root of the next tooth; it is then supposed either by the patient or the operator that the wrong tooth was extracted, whereupon that in which the pain now seems to be is drawn, but with as little benefit. I have known cases of this kind where all the teeth of the affected side of the jaw have been drawn out, and the pain has continued in the jaw; in others it has had a different effect, the sensation of pain has become more diffused, and has at last attacked the corresponding side of the tongue. In the first case I have known it recommended to cut down upon the jaw, and even to perforate and cauterize it, but all without effect.

Hence it should appear that the pain in question does not arise from any disease in the part, but is entirely a nervous affection.

It is sometimes brought on, or increased, by affections of the mind, of which I once saw a remarkable instance in a young lady.

It often has its periods, and these are frequently very regular.

The regularity of its periods gives an idea of its being a proper case for the bark, which however frequently fails.

I have seen cases of some years' standing, where the hemlock has succeeded when the bark has had no effect; but sometimes all attempts prove unsuccessful. Sea-bathing has been in some cases of singular service.*

* [The disease here treated of is evidently that which has since the time of Hunter been so often treated of under the terms Neuralgia and Tic-douloureux. It is unnecessary here to say much on the subject of this disease when arising from constitutional causes, in which case, I believe, the periodical character will almost always distinguish it; but it may not be useless to offer a few observations on those cases of local neuralgia which are more or less connected with the teeth, and which more or less nearly stimulate tic-douloureux, especially when occurring in a constitution predisposed to that affection. It appears that the pres-

CHAPTER V.

OF THE EXTRANEOUS MATTER UPON THE TEETH.

There are parts of the tooth which lie out of the way of friction, viz. the angles made by two teeth, and the small indentation between the tooth and gum.

Into these places the juices are pressed, and there stagnate, giving them at first the appearance of being stained or dirty. A tooth in this stage is generally clean for some way from its cutting edge towards the gum, on account of the motion of the lips upon it, and the pressure of the food, &c. It is also pretty clean close to the gum from the motion of the loose edge of the gum upon that part; but this circumstance is only observable in those who have their gums perfectly sound, for in others this loose edge of the gum is either lost, or no longer retains its free motion.

If art be not now used, as the natural motion of the parts is not sufficient, the incrustation increasing covers more and more of the teeth. As mastication generally keeps that part clear which is near to the edges and grinding surfaces, and as the motion of the lips in some measure retards its growth outwards, it accumulates on the parts above mentioned till it rises almost as high as the gum; its growth being now retarded in that direction, it accumulates on the edge next to the gum, so that in time it passes over the gum, of which it covers a greater or less portion. When it has increased so much as to touch the gum (which very soon happens, especially in the angle between the teeth), it produces ulceration of that part, and a train of bad consequences. Often the gums, receding from this matter, become very tender and subject to hemorrhage.

The alveolar processes frequently take part with the gums, and ulcerate, so that the teeth are left without their support, and at last drop out similarly to the diseases of these parts already described.

All our juices contain a considerable quantity of calcareous earth, which is dissolved in them, and which is separated from them upon

sure of any extraneous body on the fibre of a nerve will produce the peculiar pain in question. Hence it not unfrequently happens that the deposit of bony matter on the extremity of the root of a tooth, the existence of a dead tooth, and any other similar cause will produce it. I have seen a case in which every constitutional remedy, usually employed in tic-douloureux, had been employed without effect for an affection of this kind, which had become excessively violent in its attacks; and on learning that it had existed ever since the extraction of a tooth, the part was carefully examined, and a small spicula of the alveolar process was discovered under the edge of the gum, on touching which the paroxysm of pain was instantly excited. The removal of this spicula was at once successful. This case is here mentioned to show how trifling a cause may produce the most severe pains of this description, and to point out the necessity for a careful and even minute examination of the part in which the pain appears to commence.]

exposure, which continues mixed with the mucus; so that the extraneous matter consists of earth and the common secreted mucus.*

This disposition of the juices of the mouth to abound so much with earth, seems to be peculiar to some people, perhaps to some constitutions; but I have not been able to ascertain what these are. We find persons who seem to have nothing particular either in constitution or way of life so subject to this accumulation that the common methods of prevention, such as washing and brushing the teeth, have not the desired effect.

The disposition is so strong in some people that the concretion forms on the whole body of the tooth; I have seen it even on the grinding surface of the molares, and often two or three teeth are cemented together with it. This I think could only happen to those who seldom or never use these teeth. It is very apt to accumulate on a tooth the opposite of which is lost.

I once saw a case of this kind where the accumulation, which was on a grinder, appeared like a tumour on the inside of the mouth, and made a rising in the cheek, which was supposed by every one that felt it to be a scirrhous tumour forming on the cheek; but it broke off and discovered what it was.

This accumulation is very apt to begin during a fit of sickness, when the extraneous juices are allowed to rest; and perhaps the juices themselves may have at this time a greater tendency to produce the incrusting matter.

It may also arise from any circumstance which prevents a person from eating solids, whereby the different parts of the mouth have less motion on each other. Lying-in women are instances of this; not to mention that the assistance of art in keeping the teeth clean is commonly wanting under such circumstances.

The adventitious substance, as was said before, is composed of mucus, or animal juices, and calcareous earth; the earth is attached to and crystallized upon the tooth, and the mucus is entangled in these crystals.

The removal of this adventitious matter is a part in which the dentist ought to be very cautious; he should be perfectly master of the difference between the natural, or original, tooth and the adventitious matter; and he should be sensible of the propriety of saving as much as possible of the tooth, and at the same time take pains to remove all that which is not natural. Many persons have had their teeth wholly spoiled by an injudicious treatment of them in this respect.

As the cause of this incrustation is not either a known disease of the constitution or of the parts, but depends on a property of the matter secreted, simply as inanimate matter, the remedy of course becomes either mechanical or chemical.

The mechanical remedies are friction, filing, and picking. The

* Vide Natural History, page 57, in the note, for a further description of this.

first is sufficient when the teeth are only beginning to be discoloured; or, when already clean, they may be thus kept clean. Various are the methods proposed: to wash them with cold water, and at the same time to rub them with a piece of cloth on the fore finger, has been thought sufficient by some; others have recommended the dust of a burnt cork, burnt bread, &c., with a view to act with more power on the adventitious matter than what can be applied by the means of a soft brush or cloth.

In cases where this incrustation has been more considerable, powders of various kinds have been employed, such as tartar, bole, and many others.

Cream of tartar is often used, which at the same time that it acts mechanically, has likewise a chemical power, and dissolves this matter.

Other mechanical means are instruments to pick, scrape, and file off the calcareous earth; these should only be made use of when it is in large quantities, and with great caution, as the teeth may be somewhat loose; or a part of the tooth may be broken off with the incrustation.

The chemical means are solvents: these are either alkalies or acids; the alkaline salt will answer very well early in the disease, for the crust in the first stage consists chiefly of mucus, which the alkali will remove very readily; but it should not be used too freely, as it rather softens the gums, and makes them extremely tender.

Acids are also employed with success, as they dissolve the earth, but are attended with this disadvantage, that they act with more force upon the tooth itself, dissolving part of it; which is to be avoided, if possible, for no part of a sound tooth can be spared.

We may observe that people who eat a good deal of salad or fruit have their teeth much cleaner than common, which is owing to the acids in those fruits; and for the same reason people's teeth are commonly cleaner in summer than winter in those countries where there is a great plenty of fruit. When the accumulation has been considerable, the teeth and gums will feel tender on the removal of this matter, and even be affected by cold air; but this will not be of long continuance.

CHAPTER VI.

OF THE IRREGULARITY OF THE TEETH.

As that part of each jaw which holds the ten fore teeth is exactly of the same size when it contains those of the first set as when it contains those of the second, and as these last often occupy a much larger space than the first,* in such cases the second set are obliged to stand very irregularly.

* Natural History, p. 48.

This happens much oftener in the upper jaw than in the lower, because the difference of the size of the two sets is much greater in that jaw.

This irregularity is observed almost solely in the incisores and cuspidati; for they are the only teeth which are larger than their predecessors.

It most frequently happens to the cuspidati, because they are often formed later than the bicuspides; in consequence of which the whole space is taken up before they make their appearance: in such cases they are obliged to shoot forwards or outwards over the second incisor. However, it frequently happens to the incisores, but seldom to such a degree. This arises often from the temporary cuspidatus of one or both sides standing firm. I have seen the irregularities so much as to appear like a double row.

The bicuspides generally have sufficient room to grow, because even more space than what they can occupy is kept for them by the temporary grinders.* This, however, is not universally the case; for I have seen where the bicuspides were obliged to grow out of the circle, very probably from their being later in growing than common.

That it is from want of room in the jaw, and not from any effect that the first set produces upon them, is evident: first, because in all cases of irregularity we find that there is really not room in the jaw to allow of placing all the teeth properly in the circle; so that some are necessarily on the outside of the circle, others within it, while others are turned with their edges obliquely, as it were warped; and secondly, because the bicuspides are not out of the circle, although they are as much influenced by the first set as any of the others.

As they are not influenced by the first set, it cannot be of any service to draw the first possessor, for that gives way in the same proportion as the other advances. As the succeeding tooth, however, is broader, it often interferes with a shedding tooth next to it, the fang of which not being influenced by the growth of its own succeeding tooth, it does not decay in proportion as the other advances, and therefore the drawing of the adjoining shedding tooth is often of service.†

In cases of considerable irregularity for want of room, a principal object is to remove those which are most out of their place, and thereby procure room for the others which are to be brought into the circle.

To extract an irregular tooth would answer but little purpose if no alteration could be made in the situation of the rest; but we find that the very principle upon which teeth are made to grow irregularly is capable, if properly directed, of bringing them even again. This principle is the power which many parts (especially bones) have of moving out of the way of mechanical pressure.

*Natural History, p. 40. †Ibid., p. 50.

The irregularity of the teeth is at first owing to mechanical pressure; for one tooth getting the start of another, and fixing firmly in its place, becomes a resistance to the young, loose, forming tooth, and gives it an oblique direction. The same principle takes place in a completely formed tooth whenever a pressure is made upon it. Probably a tooth might by slow degrees be moved to any part of the mouth, for I have seen the cuspidati pressed into the place of the incisores. However, it is observed that the teeth are easier moved backwards than forwards, and when moved back that they are permanent, but often when moved forwards that they are very apt to recede.

The best time for moving the teeth is in youth, while the jaws have an adapting disposition; for after a certain time they do not so readily suit themselves to the irregularity of the teeth. This we see plainly to be the case when we compare the loss of a tooth at the age of fifteen years and at that of thirty or forty. In the first case we find that the two neighbouring teeth approach on another, in every part alike, till they are close; but in the second the distance in the jaw between the two neighbouring teeth remains the same, while the bodies will in a small degree incline to one another from want of lateral support.

And this circumstance of the bodies of the teeth yielding to pressure upon their base, shows that even in the adult they might be brought nearer to one another by art properly applied.

As the operation of moving the teeth is by lateral pressure upon their bodies, these bodies must first have passed through the gum sufficiently for a hold to be taken.

The best time seems to be, when the two grinders of the child have been shed; for at this time a natural alteration is taking place in that part of the jaw.

The means of making this pressure I shall only slightly describe, as they will greatly vary according to circumstances, so considerably, indeed, that scarcely two cases are to be treated alike, and in general the dentists are tolerably well acquainted with the methods.

In general, it is done with ligatures or plates of silver. The ligatures answer best when it is only required to bring two teeth closer together, which are pretty much in the circle. The trouble attending this is but trifling, as it is only that of having them tied once a week or fortnight.

Where teeth growing out of the circle are to be brought into it, curved silver plates, of a proper construction, must be used. These are generally made to act on three points, two fixed points on the standing teeth, and the third on the tooth which is to be moved. That part of the plate which rests on the two standing teeth must be of a sufficient length for that purpose, while the curved part is short, and goes on the opposite side of the tooth to be moved. Its effect depends very much on the attention of the patient, who must frequently press hard upon it with the teeth of the opposite jaw; so

that this method is much more troublesome to the patient than the ligature.

It is impossible to give absolute directions what tooth or teeth ought to be pulled out. That must be left to the judgment of the operator; but the following general hints may be of service.

1. If there is any one tooth very much out of the row, and all the others regular, that tooth may be removed, and the two neighbouring ones brought closer together.

2. If there are two or more teeth of the same side very irregular (as, for instance, the second incisor and cuspidatus), and it appears to be of no consequence, with respect to regularity, which of them is removed, I should recommend the extraction of the furthest back of the two, viz. the cuspidatus; because, if there should be any space not filled up when the other is brought into the row, it will not be so readily seen.

3. If the above-mentioned two teeth are not in the circle, but still not far out of it, and yet there is not room for both, in such a case, I would recommend the extraction of the first bicuspis, although it should be perfectly in the row, because the two others will then be easily brought into the circle, and if there is any space left, it will be so far back as not to be at all observable.

The upper jaw is often rather too narrow from side to side, near the anterior part which supports the fore teeth, and projects forwards considerably over the lower, giving the appearance of the rabbit-mouth, although the teeth be quite regular in the circle of the jaw.

In such a case it is necessary to draw a bicuspis of each side, by which means the fore part of the circle will fall back; and if a cross-bar was to be stretched from side to side across the roof of the mouth, between cuspis and cuspis, it would widen the circle. The fore teeth might also be tied to this bar, which would be a means of assisting nature in bringing them back. This has been practised, but it is troublesome.

As neither the bodies nor the fangs of the teeth are perfectly round, we find that this circumstance often becomes a cause of their taking a twist; for, while growing, they may press with one edge only on the completely formed tooth, by which means they will be turned a little upon their centre.

The alteration of these is more difficult than of the former, for it is, in general, impossible to apply, so long and constantly as is necessary for such an operation, any pressure that has the power of turning the tooth upon its centre. However, in the incisores, it may be done by the same powers which produce the lateral motion; but where these cannot be applied, as is frequently the case, the tooth may be either pulled out entirely, and put in again even, or it may be twisted round sufficiently to bring it into a proper position, as has been often practised.

It may not be improper, in this place, to take notice of a case which frequently occurs. It is a decay of the first adult grinder at

an early age, viz. before the temporary grinders are shed, and before the second grinder of the adult has made its appearance through the gum. In this case, I would recommend removing the diseased tooth immediately, although it may occasion no kind of trouble; for, if it be drawn before the temporary grinders are shed, and before the second adult grinder has cut the gum, it will in a short time not be missed; because the bicuspis of that side will fall a little back, and the second and third grinders will come a little forward, by which means the space will be filled up, and these teeth will be well supported. Besides, the removal of this tooth will make room for the fore teeth, which are often very much wanted, especially in the upper jaw.*

CHAPTER VII.

OF IRREGULARITIES BETWEEN THE TEETH AND JAWS.

Certain disproportions between the teeth and jaw sometimes occur, one of which is, when the body of the lower jaw is not of sufficient length for all the teeth. In such cases, the last grinder never gets perfectly from under the coronoid process, its anterior edge only being uncovered; and the gum, which still in part lies upon the tooth, is rubbed against the sharp points of the tooth, and is often squeezed between the tooth upon which it lies and the corresponding one of the upper jaw. This occasions so much uneasiness to the patient, that it becomes necessary to relieve the gum, if possible, by dividing it freely in several places, that it may shrink and leave this surface of the tooth wholly uncovered. If this does not answer, which is sometimes the case, it is advisable to draw the tooth.

Sometimes, although but seldom, an inconvenience arises from the dentes sapientiæ being in the upper jaw and not in the lower; these teeth pressing upon the anterior part of the root of the coronoid process when the mouth is shut; for the coronoid processes are

* [The foregoing observations on irregularity are generally very judicious; and it would have been well if many writers on this subject had imitated the moderation which characterizes the mode of treatment here recommended. It is in the treatment of the teeth of children during the second dentition that we have in the present day chiefly to deplore the continual interference of interested ignorance, in the early removal of the temporary teeth, under the pretence of *making room* for the permanent ones. It is impossible too often or too forcibly to deprecate this practice. Cruel as it is, this is perhaps its least evil, for the pain and apprehension which are occasioned by it are but temporary; but a great permanent disadvantage follows this practice, which is, that if the temporary teeth be removed before the permanent ones are ready to fall into their place, the jaw will considerably contract during the growth of the child, and thus create a discrepancy between the size of the new teeth and the extent of the arch which they occupy. I feel assured that, upon the whole, more injury is at present done, with regard to irregularity, by the interference of dentists, than would accrue were the teeth of children at this period never examined or meddled with at all.

further forwards in such cases than when the lower jaw also has its dentes sapientiæ; in short, the exact correspondence between the two jaws is not kept up.

In such cases, I know of no other remedy but the extraction of the tooth.

Of Supernumerary Teeth.

When there are supernumerary teeth,* it will in general be proper to have them drawn, for they are commonly either troublesome, or disfigure the mouth.

CHAPTER VIII.

OF THE UNDER JAW.

It is not uncommon to find the lower jaw projecting too far forwards, so that its fore teeth pass before those of the upper jaw when the mouth is shut;† which is attended with inconvenience, and disfigures the face.

This deformity can be greatly mended in young people. The teeth in the lower jaw can be gradually pushed back, in those whose teeth are not close, while those in the upper can be gently brought forward; which is by much the easiest operation.

These two effects are produced by the same mechanical powers. While this position of the jaw is only in a small degree, so that the edges of the under teeth can be by the patient brought behind those of the upper, it is in his own power to increase this till the whole be completed, that is, till the grinders meet; and it is not necessary to go further. This is done by frequently bringing the lower jaw as far back as he can, and then squeezing the teeth as close together as possible.

But when it is not in the person's power to bring the lower jaw so far back as to allow the edges of its fore teeth to come behind those of the upper, artificial means are necessary.

The best of these means is an instrument of silver, with a socket or groove shaped to the fore teeth of the lower jaw to receive them, so as to become fast to them, and sloped off as it rises to its upper edge, so as to rise behind the fore teeth in the upper jaw in such a manner that, upon shutting the mouth, the teeth of the upper jaw may catch the anterior part of the slanting surface, and be pushed forward with the power of the inclined plane. The patient who wears such an instrument must frequently shut his mouth with this view.

These need not be continued longer than till the edges of the lower teeth can be got behind those of the upper, for it is then within the power of the patient, as in the first-stated case.

* Natural History, p. 49. † Ibid. p. 35.

CHAPTER IX.

OF DRAWING THE TEETH.

The extraction of teeth is in some cases an operation of considerable delicacy, and in others no operation is less difficult.

As this is often not thought of till an inflammation has come on, it becomes an object of consideration whether it be proper to remove the tooth while that inflammation continues, or to wait till it has subsided. I am apt to believe it is better to wait even till the parts have perfectly recovered themselves, because the state of irritation renders them more susceptible of pain. The contrary practice might also appear reasonable, for by removing the tooth it might be imagined that we should remove the cause; but when the inflammation has once begun, the effect will go on independently of the cause; and to draw the tooth, in such a situation, is rather to produce a fresh cause, than to remove the present. Of this I think an instance has occurred to me. However, most teeth are drawn in the height of inflammation; and, as we do not find any mischief from the operation, it is perhaps better to do it when the resolution of the patient is the greatest. The sensibility of the mind may even be less at this time.

Teeth are easy or difficult of extraction, according as they are fast or loose in their sockets; in some degree according to the kind of tooth, and also in some degree with reference to their situation.*

They are naturally so fast as to require instruments, and the most cautious and dextrous hand; and yet are sometimes loose enough to be pulled out by the fingers.

When the sockets and gums are considerably decayed, and the tooth or teeth very loose, it would in most cases be right to perform extraction; for when they are allowed to stay, and perhaps are kept in their proper place by being tied to the neighbouring teeth, then they act upon the remaining gum and socket as extraneous bodies, producing ulceration there, and making those parts recede much further than they naturally would have done if the tooth had been drawn earlier; which produces two bad effects—it weakens the lateral support of the two neighbouring teeth, and it renders it more difficult to fix an artificial tooth. But unless these two last circumstances are forcibly impressed upon the patient, it is hardly possible to persuade him to consent to the loss of a tooth while it has any hold, especially a tooth which appears sound.

The extraction should never be done quickly; for this often occa-

* For further directions, see Natural History, p. 56.

sions great mischief, breaking the tooth or jaw; on the same principle as a bullet going against an open door with great velocity will pass through it, but with little velocity will shut it.

This caution is most necessary in adults, or in the permanent teeth;* for in young subjects, where there are only the temporary teeth,† the jaw not being so firm, the tooth is not in much danger of being broken.‡

It is a common practice to divide the gum from the tooth before it is drawn, which is attended with very little advantage, because at best it can only be imperfectly done, and that part of the gum which adheres to the tooth decays when it is lost. But if such a separation as can be made saves any pain in the whole of the operation, I should certainly recommend it; and at least, in some cases, it might prevent the gum from being torn. It is also a common practice to close the gum, as it is termed; this is more for show than use; for the gum cannot be made so close as to unite by the first intention, and therefore the cavity from which the tooth came must suppurate like every other wound. But, as the sensations of these parts are adapted to such a loss, and as a process very different from that which follows the loss of so much substance in any other part of the body is to take place, the consequent inflammations and suppurations are not so violent.§ We may be allowed to call this a natural operation which goes on in the gum and alveoli, and not a violence; as we see that the delivery of a young animal before its time, which is similar to the drawing of a fixed tooth, in happening before all the containing parts are prepared for the loss, produces considerable local violence, without doing proportionable mischief. Therefore in general it is very unnecessary to do anything at all to the gum.

There are some particular circumstances which naturally, and others which accidentally, attend and follow the drawing of teeth; but they are in general of no great consequence.

There follows a bleeding from the vessels of the socket and those passing between it and the teeth.‖ This commonly is but trifling; however, instances has occurred where it have been very considerable, and the awkwardness of the situation makes it very difficult to stop it. In general it will be sufficient to stuff the socket with lint, or lint dipped in the oil of turpentine, and to apply a compress of lint, or a piece of cork thicker than the bodies of the adjacent teeth, so that the teeth in the opposite jaw may keep up a pressure.

It has been advised to stuff into the socket some soft wax, on a supposition that it would mould itself to the cavity, and so stop the

* Natural History, p. 40. † Ibid. Pl. V. f. 16, 17, 18.

‡ I must do Mr. Spence the justice to say, that this method appears to be peculiar to him, and that he is the only operator I ever knew who would submit to be instructed, or even allow an equal in knowledge; and I must do the same justice to both his sons.

§ Vide Natural History, on decay of the alveoli, p. 12.

‖ Natural History, pp. 25, 26, Pl. V. f. 1—8.

bleeding; this perhaps may sometimes answer better than the other method, and therefore should be tried when that fails.

It is scarcely possible to draw some teeth without breaking the alveolar processes. This in general is but of little consequence, because, from the nature of the union between the teeth and sockets, these last can scarcely be broken further than the points of the fang, and in very few cases so far; therefore little mischief can ensue, as the fracture extends no further than the part of the socket which will naturally decay after the loss of the tooth; and that part which does not decay will be filled up as a basis for the gum to rest upon. It has been supposed that the splinters do mischief: I very much doubt this; for if they are not so much detached as to lose the living principle, they still continue part of our body, and are rounded off at their points, as all splinters are in other fractures, and particularly here, for the reasons already assigned, viz. because the part has a greater disposition for wasting. And if they are wholly detached they will either come away before the gum contracts entirely, or after it is closed will act as an extraneous body, form a small abscess in the gum, and come out.

It sometimes happens that the tooth is broken, and its point or more of the fang is left behind, which is very often sufficient to continue the former complaints; and therefore it should be extracted, if it can be done, with care. If it cannot be extracted the gum will in part grow over it, and the alveoli will decay as far as where it is. The decaying principle of the socket will produce the disposition to fill up at the bottom, whereby the stump will be pushed out; but, perhaps, not till it has given some fits of the tooth-ache. However, this circumstance does not always become a cause of the tooth-ache.

Transplanting Teeth.

Although this operation is in itself a matter of no difficulty, yet upon the whole it is one of the nicest of all operations, and requires more chirurgical and physiological knowledge than any that comes under the care of the dentist. There are certain cautions necessary to be observed, especially if it be a living tooth which is to be transplanted, because in that case it is meant to retain its life, and we have no great variety of choice. Much, likewise, depends upon the patient; he should apply early, and give the dentist all the time he thinks necessary to get a sufficient number of teeth that appear to be of a proper size, &c. Likewise he must not be impatient to get out of his hands before it is advisable.

The incisores, cuspidati, and bicuspides can alone be changed, because they have single fangs. The success is greater in the incisores and cuspidati than the bicuspides, these last having frequently the ends of their fangs forked, from which circumstance the operation will become less perfect.

It is hardly possible to transplant the grinders, as the chance of

fitting the sockets of them is very small. When indeed a grinder is extracted, and the socket sound and perfect, the dentist may, perhaps, be able to fit it by a dead tooth.

Of the State of the Gums and Sockets.

The first object of attention is the sockets and gums of the person who is to have the fresh tooth. If the tooth which is to be removed be not wholly diseased, there is great probability that the socket will be as sound and complete as ever; but if the body of the tooth has been destroyed some time, and the fang has been in the state of what is commonly called a stump, it has most probably begun to decay on its outer surface and point, in which case the socket will be filled up in the same proportion; if so, there is no possibility of success. But as, in the operation of transplanting, the diseased tooth is to be first drawn, it will show the state of the socket; and the scion* tooth is to be left or drawn, according to the appearance on the diseased one.

If the appearance be not favourable, and it therefore be not probable that the scion tooth can be introduced, so as to unite in the place of the stump, I would recommend to every dentist to have some dead teeth at hand, that he may have a chance to fit the socket. I have known these sometimes last for years, especially when well supported by the neighbouring teeth. Indeed this very practice is recommended by some dentists in preference to the other. But even this should not be attempted unless the socket is sound and pretty large, as the tooth can otherwise have but very little hold.

Whenever there are gum-boils I would not recommend transplanting, as there is always in such cases a diseased socket, although the disease has originated in the tooth. In one or two instances, indeed, which I have seen, the boil has been cured by such an operation.

If the gums are diseased, and become spongy, as has been described, it will be very improper to transplant, as there will be but little chance of success; also, if the sockets have a disposition to waste, and the tooth becomes in some degree loose; in short, the sockets and gums should be perfectly sound. No person should have a tooth transplanted while taking mercury, even although the gums are not affected by it at the time, for they may become affected by that medicine before the tooth is fixed. I would carry this still further; no one should have a tooth transplanted who has any complaint that may subject him to the taking of mercury before the tooth is well fixed. For this reason, those who have teeth transplanted ought particularly to avoid for some time the

* As the transplanting of teeth is very similar to the ingrafting of trees, I thought that term might be transferred from gardening to surgery, finding no other word so expressive of the thing.

chance of contracting any complaint for the cure of which mercury may be necessary.

I would not recommend transplanting, even where mercury has been taken lately. How soon mercury may be taken after a tooth has been transplanted is not easily ascertained. I have known it fail from this cause (as it seemed) after six weeks, where there was every reason to suppose that it might have been attended with success.

Of the Age of the Person who is to have the Scion Tooth.

The socket should be of its full size, and one or two grinders on each side of each jaw should be full grown, to keep the two jaws at a proper distance, which will allow the transplanted tooth to be undisturbed by the motion of the jaw while fastening. This will be at the age of eighteen or twenty years.

It sometimes, however, happens that a fore tooth decays before this age, and even before it is completely formed ; and therefore all the above-mentioned advantages cannot be had. In such cases it is not very material whether transplanting is practised or not, as simply to draw the diseased tooth will in most cases be sufficient, for the two neighbouring teeth may be brought together, so as to fill up the space, the others following in a less degree, as has been already observed upon irregularities of the teeth.

Of the Scion Tooth.

The scion tooth, or that which is to be transplanted, should be a full-grown young tooth; young, because the principle of life and union is much stronger in such than in old ones.

It will be scarcely necessary to observe, that the new teeth should always be perfectly sound, and taken from a mouth which has the appearance of that of a person sound and healthy ; not that I believe it possible to transplant an infection of any kind from the circulating juices, although we know from experience that it may be done by a matter secreted from them. The scion tooth should be less than what the tooth was, the place of which it is to supply. This cannot at first be known with certainty, but it may in most cases be nearly ascertained, and that is by judging from the size of the bodies of the two teeth ; but as the fangs do not always bear an exact proportion to the body, it sometimes happens that this method fails. Also it is not always in our power to judge after this manner, for in some cases the body of the tooth of the person who is to have one transplanted shall be quite destroyed, the fang only remaining : in these cases we must judge from its correspondent on the opposite side ; but even that tooth is sometimes destroyed.

It has been supposed that we run no risk by taking the scion tooth from a young subject; but this is no security, for a complete

tooth is of the same size in the young as the old.* To remedy this inconvenience as much as possible, the scion tooth should be that of a female, for female teeth are in general smaller than those of men; but the inconvenience still remains whenever a female is the subject of this operation. Some women have such small teeth that it is almost impossible to fit them. When the fang of the scion tooth is larger than that which it is intended to supply, it must be made smaller, and only in that part where it exceeds. But the necessity of this should be avoided if possible, for a tooth that is filed has lost all those inequalities which allow it to be held much faster. If, however, some part must be removed, it should be done so as to imitate the old tooth as much as possible. The best remedy is to have several people ready whose teeth in appearance are fit, for if the first will not answer, the second may. I am persuaded this operation has failed, from a tooth being forced in too tight, for let us reflect what must be the consequence of such practice. A part of the soft covering of the tooth, or lining of the socket, is squeezed between two hard bones, so that all circulation of juices is prevented; a mortification in that part takes place; and in consequence of that a gum-boil, and the loss of all union between tooth and socket, so that the tooth drops out.

It will be hardly necessary to mention that the sooner the scion tooth is put into its place the better, as delay will perpetually lessen the power upon which the union of the two parts depends.†

Of replacing a sound Tooth when drawn by mistake.

It sometimes happens that a tooth is drawn on an idea that it is diseased, because it gives pain, but appears after the extraction to be perfectly sound. In such a case I would recommend the replacing it, that there may be no loss by the operation; and the seat of the pain will probably be removed to the next tooth. A tooth beat out by violence should be replaced in the same manner. This ought to be done as soon as possible; however, I would even recommended the experiment twenty-four hours after the accident, or as long as the socket will receive the tooth, which may be for some days.

If the tooth be replaced at any time before its life is destroyed, it will reunite with the cavity of the socket, and be as fast as ever.

No tooth is excepted from this practice, for although in the grinders there are more fangs than one, yet these fangs will as readily go into their respective sockets as one fang would; and most probably when the tooth has been beat out, the sockets are enlarged by their giving way.

However, the grinders are not so subject to such accidents as

* Natural History, p. 51, on the Growth of Teeth.

† See Natural History of Teeth, pp. 57, 58, for an explanation of the principle upon which the success of this operation depends.

the fore teeth, both from their situation and from their firmness in the sockets.

Where a tooth has been only loosened, or shoved out in part, the patient must not hesitate, but must replace it immediately. As a proof of the success to be expected from replacing teeth, I will relate the following case.

A gentleman had his first bicuspis knocked out, and the second loosened. The first was driven quite into his mouth, and he spit it out upon the ground, but immediately picked it up and put it into his pocket. Some hours afterwards he called upon me, mentioned the accident, and showed me the tooth. Upon examining his mouth, I found the second bicuspis very loose, but pretty much in its place. The tooth which had been knocked out was not quite dry, but very dirty, having dropped on the ground, and having been some time in his pocket. I immediately put it into warm water, let it stay there to soften, washed it as clean as possible, and then replaced it, first having introduced a probe into the socket to break down the coagulated blood which filled it. I then tied these two teeth to the first grinder, and the cuspidatus with silk, which was kept on some days, and then removed. After a month they were as fast as any teeth in the head, and if it were not for the remembrance of the circumstances above related, the gentleman would not be sensible that his teeth had met with any accident. Four years have now passed since it happened.

Of transplanting a dead Tooth.

The insertion of a dead tooth has been recommended, and I have known them continue for many years. If this always succeeded as well as the living I would give it the preference, because we are much more certain of matching them, as a much greater variety of dead teeth can be procured than of living ones. But they do not always retain their colour, but are susceptible of stain. However, I have known them last for years without any alteration; and some have appeared rather to acquire a transparency, which dead teeth in general have not.

Of the immediate Fastening of a transplanted Tooth.

When a tooth has been transplanted, the next thing to be done is to fix it in that position in which it is intended to remain, that is, in general, to the two neighbouring teeth, by means of silk or sea-weed. If it is an incisor or cuspidatus, the silk should first be tied to the neck of one of the neighbouring teeth, as near the gum as possible; then the two ends of the silk should be brought round upon the body of the scion tooth, but not so near the gum as in the former, and tied there; then it should be brought round the neck of the other neighbouring tooth, as near the gum as possible, as in the first, and tied there. The reason of the difference of the heights

of the silk recommended must appear evident, it being our intention to keep the tooth close to the bottom of the socket.

If the transplanted tooth be a bicuspis, the same mode of tying may be followed; but the silk may be brought over its grinding surface between the two points, by which it will be better confined than in any other way. It sometimes happens that the body of the scion tooth is either too long, too thick, or in such a position as to be pressed upon by the teeth of the opposite jaw. Great care should be taken to prevent this, as the opposite teeth constantly oppose the fastening of those which are transplanted, in every motion of the jaw. To remedy this inconvenience, we have recommended smaller teeth than those lost; but even when they are of a proper size in other respects they will in some cases still touch the opposite teeth. When this arises from length of the tooth, a small portion may be filed off from the cutting edge with great safety. If it is owing to the thickness of the scion tooth, and in the upper jaw, some part may be filed off the hollow or concave surface of the tooth directly opposed to it. When it is owing to the position of the teeth, the same thing may be done with propriety. By attending to this circumstance in the tying, this inconvenience may in many cases be prevented: however, if it should not be in the power of the dentist to prevent it by the above-mentioned method, then he should bring them forwards by tying them to a silver plate, a little more bent than the circle of the teeth, and resting at each end upon the neighbouring teeth.

Where a tooth does not exactly fit, but is too short, then there arises a difficulty with the patient whether he ought to consult propriety or beauty. The tooth should be as much in the socket as it can be with ease, for although in that case it is too short, appearances must give way.

The patient must now finish the rest. He must be particularly attentive at first, and give it as little motion as possible. In many cases a soreness will continue some days, and the gums will swell; in others there will neither be soreness nor swelling.

The patient must take great care not to catch cold, or expose himself to any of the other common causes of fever, for such accidents are very likely to prevent the success of this operation. This caution is more necessary in the winter than the summer.

The tooth in some will begin to be fast in a few days, and the gum will cling close to it; while in others many weeks will pass before this happens, though the tooth may become fixed at last.

I have seen the transplanted tooth come a little way out of the socket, and, without any art being used, retire into it as far as at first. The silk is to be removed sooner or later, according as the tooth is more or less fast; in some people after a fortnight, in others not till some months after the operation.

This operation, like all others, is not attended with certain success. It sometimes happens that the two parts do not unite, and in

such cases the tooth often acts as an extraneous body,* and instead of fastening, the tooth becomes looser and looser, the gum swells, and a considerable inflammation is kept up, often terminating in a gum-boil. In some cases, where it is also not attended with success, there are not these symptoms; the parts appear pretty sound, only the teeth do not fasten, and sometimes drop out.

It also happens that transplanted teeth have a very singular operation performed on them while in the socket; the living socket and gum finding this body kept in by force, so that they cannot push it out, set about another mode of getting rid of it, by eating away the fang till the whole is destroyed, exactly similar to the wasting of the fangs of the temporary teeth in the young subject.†

I have all along supposed, that where this practice is attended with success there is a living union between the tooth and socket, and that they receive their future nourishment from this new master. My reasons for supposing it were founded on experiments on other parts,‡ in animals, and also observations made on the practice itself; for first I observed that they kept their colour, which is very different from that of a dead tooth; for a living tooth has a degree of transparency, while a dead one is of an opaque chalky white.

Secondly, there are instances of their becoming diseased, in the same manner as an original living tooth; at least the following case favours strongly this opinion.

In October 1772, a gentleman of the city of London had a tooth transplanted, which was perfectly sound, and fixed in its new socket extremely well; about a year and a half after two spots were observed on the fore part of the body of the tooth, which threatened a decay; they were exactly similar to specks, or the first appearance of decay, which come upon natural living teeth. Pain is also sometimes felt in the transplanted tooth.

But what puts it beyond a doubt is, that a living tooth, when transplanted into some living part of an animal, will retain its life; and the vessels of the animal shall communicate with the tooth, as is shown by the following experiments.

I took a sound tooth from a person's head; then made a pretty deep wound with a lancet into the thick part of a cock's comb, and pressed the fang of the tooth into this wound, and fastened it with threads passed through other parts of the comb. The cock was killed some months after, and I injected the head with a very minute injection; the comb was then taken off and put into a weak acid, and the tooth being softened by this means, I slit the comb and tooth into two halves, in the long direction of the tooth. I found the vessels of the tooth well injected, and also observed that the exter-

* I say often, because I do not suppose that it always acts as an extraneous body; because we know that dead teeth have stood for years without affecting the sockets or gums in the least. We may therefore suppose that it is sometimes the case with transplanted living teeth.

† Natural History, p. 47, Pl. V. f. 16, 17. ‡ Natural History, p. 57.

nal surface of the tooth adhered everywhere to the comb by vessels similar to the union of a tooth with the gum and sockets.* †

Of Dentition.

Teeth, at their first formation, and for some time while growing, are completely inclosed within the sockets and gums,‡ and in their growth they act upon the inclosing parts in some degree as extraneous bodies; for while the operation of growth is going on in them, another operation is produced, which is a decay of that part of the gum and socket that covers the tooth, and which becomes the cause of the very disagreeable and even dangerous symptoms which attend this process. As the teeth advance in size, they are in the same proportion pressing against these sockets or gums, from whence inflammation and ulceration are produced.

That ulceration which takes place in dentition is one of the species which seldom or never produces suppuration; however, in some few cases I have found the gums ulcerated, and the body of the tooth surrounded with matter; but I believe this seldom happens till the tooth is near cutting the skin of the gums.

As this is a disease of an early age, and indeed almost begins with life, its symptoms are more diffused, more general, and more uncertain at such an early period than those of any disorder of full-grown people, putting on the appearance of a great variety of maladies; but these symptoms become less various and less hazard-

* I may here just remark, that this experiment is not generally attended with success. I succeeded but once out of a great number of trials.

† [It is unnecessary in the present day to enter into any discussion on the merits of an operation now, I believe, wholly discontinued. From the experiments which Hunter made on the transplanting of teeth from the jaw to other situations, and the successful result of several of them, the operation in question became a favourite one with him; and it appears to have been very frequently performed either by himself or under his directions. The frequent failures which occurred, even in the operation itself, and still more the severe results which very often succeeded its performance at different periods, have very properly induced almost all subsequent practitioners to abandon its employment. Nothing but the sanguine expectations created in an ardent mind, by the interesting results which followed his first experiments, could account for a man of so sound a judgment having followed up a practice so obviously objectionable.

The experiment with which this section is closed has, however, an interest attached to it far more important than its having given rise to the temporary adoption of an objectionable operation. In the result of this experiment may be found an interesting collateral argument in favour of the organized structure of the teeth, and their actual living connexion with the body. The vessels of the tooth, we are told, were well injected, and the external surface adhered everywhere to the comb by vessels. To what purpose are these vessels formed, what object can possibly be fulfilled by the existence of a vascular pulp in the internal cavity, and a vascular periosteum covering the external surface,—so obviously vascular that it was *well* injected from the vessels of a cock's comb, into which it had been transplanted,—unless they are intended to *nourish* the bony substance of which the tooth consists, and to form the medium of its connexion with the general system?]

‡ Natural History, pp. 38 and 39, Pl. V. f. 15.

ous as the child advances in years, so that the double teeth of the child, and still more so the second set of teeth, or those of the adult, are usually cut without producing much disturbance.

These symptoms are so various in different children, and often in the same child, that it is difficult to conceive them to be from the same origin, and the varieties are such as seem to be beyond our knowledge.

They produce both local and constitutional complaints, with local sympathy.

The local symptoms we may suppose to be attended with pain, which appears to be expressed by the child when he is restless, uneasy, rubs his gums, and puts everything into his mouth. There is generally inflammation, heat, and swelling of the gums, and an increased flow of saliva.

The constitutional or general consequential symptoms are fever and universal convulsion. The fever is sometimes slight and sometimes violent. It is very remarkable both for its sudden rise and declension; so that in the first hour of this illness the child shall be perfectly cool, and in the second flushed and burning hot, and in the third temperate again.

The partial or local consequential symptoms are the most various and complicated; for the appearance they put on is in some degree determined by the nature of the parts they affect; wherefore they imitate various diseases of the human body. These symptoms we shall describe in the order of their most frequent occurrence.

Diarrhœa, costiveness, loss of appetite, eruptions on the skin, especially on the face and scalp, cough, shortness of breath, with a kind of convulsed respiration, similar to that observable in the hooping cough, spasms of particular parts, either by intervals or continued, an increased secretion of urine, and sometimes a diminution of that secretion, a discharge of matter from the penis, with difficulty and pain in making water, imitating exactly a violent gonorrhœa.

The lymphatic glands of the neck are at this time apt to swell; and if the child has a strong tendency to the scrofula, this irritation will promote that disease.

There may be many other symptoms with which we are not at all acquainted, the patients in general not being able to express their feelings. Many of the symptoms of this disease are dangerous, namely, the constitutional ones, and also those local symptoms which attack a vital part. The fever, indeed, seldom lasts so long as to be fatal; but the convulsions, especially when universal, frequently are so. Local convulsions, if not in a vital part, although very often violent, do not kill; and when any part not vital sympathizes, the patient is generally free from danger; a security to the whole being obtained by the sufferings of a part which is of little consequence to life.

Universal sympathy seems to be the first effect of irritation, and in general appears as such in those whose local and partial sensa-

tion, and irritability, are not yet formed; for in such subjects, when one part is irritated, the whole sympathizes, and general convulsions ensue. But as the sensations and partial irritability begin to be formed, each part, in some degree acting for itself, acquires its own peculiarities; so that when a local disease takes place in a patient that is very young, it is capable of giving a general disposition to sympathize; but as the child advances, the power of sympathy becomes partial, there not being now in the constitution that universal consent of parts; but some one part is found which has a greater aptitude than the rest to fall in with the local irritation; therefore the whole disposition for sympathy is directed to some particular part, and it sympathizes according to its own peculiar action. This arises from the different organs acquiring more and more their own independent sensations as the child grows older, and gradually losing the power of sympathizing with one another, so that by the age of six years few parts suffer but those immediately affected; and in adults, who cut their teeth, we almost always find the pain and other symptoms confined to the part, or only local sympathy taking place, such as a swelling of the side of the face.

But as the symptoms become more confined, the suffering part is often much more violently affected than where it has a power of taking in the other parts. Therefore we find that in adults the pain of cutting a grinder is frequently excessive, and that the local inflammation is very considerable, and often of long continuance.* This is not the case with children; their pain does not appear to be so very considerable, and we are certain that the local inflammation is not great; that it is confined to the very parts which suffer, and is not diffused over the face; so that in children the symptoms of sympathy are often more violent than those of the parts themselves. Though it is generally a fact that the symptoms of dentition in adults are confined to the parts immediately injured, it is not always or certainly so; for sometimes, as will appear from Case the fourth, there will be the strongest symptoms imaginable from sympathy, which seems to be owing to a peculiar aptitude in the constitution to universal sympathy. These pains in the adult are often periodical, having their regular and fixed periods, from which circumstance they are often supposed to be aguish, and the bark is administered, but without effect. Medicines for the rheumatism are likewise given, with as litle success, when a tooth will appear, and disclose the cause of the complaint; and by lancing the gums the cure often is performed, but the disease will recur if the gum happens to heal over the tooth, which it will very readily do if the tooth is pretty deep. As these teeth are generally slower in their growth than the others, and more especially those which come very late, they become the cause of many returns of the symptoms. How far children under this circumstance are subject to paroxysms of the disease is not an easy thing to determine; but from many of

* Vide Case the third.

their sympathetic symptoms going off and returning, it would appear that they have also their exacerbation.

Of the Cure.

The cure of diseases arising from dentition, from their nature, can only be temporary and local, even when it is directed to the real seat of the disease; and certainly every method of cure which is not so directed must prove ineffectual, as it can only operate by destroying the effect. Opiates, indeed, will in some degree take off the irritation, by destroying the sensibility of the part; but surely it would be better at once to remove the cause than to be attempting from time to time to remove or palliate the effect. When the sympathy is partial, and not in a vital part, it would be better to allow it to continue than cure it, because it may by such means become universal; for instance, if it is a diarrhœa, the best way is to allow it to go on, or at least only correct it if too violent, which is often the case. I have seen cases where the stomach and intestines have sympathized so much as almost to threaten death. The small quantity of nourishment that the stomach could admit of was hurried off by the intestines.

Of Cutting the Gums.

As far as my experience has taught me, to cut the gum down to the teeth appears to be the only method of cure. It acts either by taking off the tension upon the gum, arising from the growth of the tooth, or by preventing the ulceration which must otherwise take place.

It often happens, particularly when the operation is performed early in the disease, that the gum will reunite over the teeth; in which case the same symptoms will be produced, and they must be removed by the same method.

I have performed the operation above ten times upon the same teeth, where the disease had recurred so often, and every time with the absolute removal of the symptoms.

It has been asserted that to cut the gum once will be sufficient, not only to remove the present but to prevent any future bad symptoms from the same cause. This is contrary to experience and the known laws of animal economy; for frequently the gum, from its thickness over the tooth, or other causes, must necessarily heal up again; and the relapse is as unavoidable as the original disease.

A vulgar prejudice prevails against this practice, from an objection that if the gum is lanced so early as to admit of a reunion, the cicatrized part will be harder than the original gum, and therefore the teeth will find more difficulty in passing, and give more pain. But this is also contrary to facts; for we find that all parts which have been the seat either of wounds or sores are always more ready to give way to pressure or any other disease which attacks

either the part itself or the constitution. Therefore each operation tends to make the passing of the teeth easier.

When the teeth begin to give pain, we find them generally so far formed as to be easily discerned through the gum.

The fore teeth are to be observed at first, not on the edge of the gum, but on the fore part, making risings there, which appear whiter than the other parts; and it may be observed that the gums are broader than usual. At this period the incisions must be made pretty deep, till the tooth be felt with the instrument, otherwise little effect will be produced by the operation; and this is the general rule with respect to the depth of the incision in all cases.

When the grinders shoot into the gum, they flatten the edge of the gum and make it broad. These teeth are more easily hit by the instrument than the fore teeth.

The operation should not be done with a fine-pointed instrument, such as a common lancet, because most probably the point will be broken off against the tooth, which will make the instrument unfit for going on further, if more incisions are required.

A common lancet with its point rounded is a very good instrument, but an instrument something like a fleam would be of the most convenient shape.

There is no need of any great delicacy in the operation, the gums being very insensible parts; and to cut through the whole gum down to the teeth with certainty, when they are pretty deep, requires some force.

The gums will bleed a little, which may be of service in taking off the inflammation. I never saw a case where the bleeding either proved inconvenient or dangerous. If it ever should be troublesome, I think there could be no great difficulty in stopping it. In general, no application is necessary: the gums soon unite at the most distant part from the tooth, if it lies deep; and if it be more superficial, the thin gum soon shrinks back over the tooth, leaving it bare, and decays.

The cutting of the dentes sapientiæ is often attended with an inconvenience which does not attend the others; and this happens, I believe, only when they come very late, viz. when the jaws have left off growing. This arises from the want of room in the jaws for these late teeth; a circumstance which produces an addition to the other inconveniences arising from dentition. When it takes place in the upper jaw, the tooth is often obliged to grow backwards; and in such a position it sometimes presses on the interior edge of the coronoid process, in shutting the mouth, and gives great pain. When it takes place in the lower jaw, some part of the tooth continues to lie hid under that process, and covered by the soft parts, which are always liable to be squeezed between that tooth and the corresponding tooth in the upper jaw. To open very freely is absolutely necessary in these cases; but even that is often not sufficient. Nothing but drawing the tooth, or teeth, will remove the evil in many cases.

CASES.

It would be endless to give histories of cases exemplifying each symptom of dentition; I shall only relate a few which are singular, and which, being extraordinary, will the better enforce the propriety, in all cases, of the cure I have recommended.

Case I.—A young child was attacked with contractions of the flexor muscles of the fingers, and also of the toes. These contractions were so considerable as to keep her fingers and thumb constantly clenched, and so irregularly that they appeared distorted. All the common anti-spasmodic medicines were given, and continued for several months, but without success.

I scarified the gums down to the teeth, and in less than half an hour all the contractions had ceased. This, however, only gave relief for a time. The gums healed; the teeth continued to grow, and filled up the new space acquired by the scarifications; and the same symptoms appeared a second time.

The former operation was immediately performed, and with the same success.

Case II.—A boy, about two years of age, was taken with a pain and difficulty in making water, and voided matter from the urethra. I suspected that, by some means or other, this child might possibly be affected by the venereal poison; and the suspicion naturally fell on the nurse.

These complaints sometimes abated, and would go off altogether, and then return again. It was observed at last that they returned only upon his cutting a new tooth. This happened so often, regularly and constantly, that there was no reason to doubt that it was owing to that cause.

Case III.—A lady, about the age of five or six and twenty years, was attacked with a violent pain in the upper jaw, which at last extended through the whole side of the face, similar to a violent toothache from a cold, and was attended with consequent fever.

It was treated at first as a cold; but, from its continuance, was afterwards supposed to be nervous.

The case was represented to me from the country, and I gave the best directions that I could, on a representation of the symptoms.

She came to London some months after, still labouring under the same complaint. Upon examining the mouth, I observed one of the points of the dens sapientiæ ready to come through. I lanced the gums, and the disorder gave way immediately.

A lady, about the same age, was attacked with a violent pain in the left side of her face. It was regularly periodical, coming on at six o'clock in the evening. She took the Peruvian bark, which had no effect. She took antimonials, and Dover's powder, which also were equally ineffectual. But one of the points of the dens sapientiæ of the upper jaw of the same side appearing, showed the cause, and indicated the remedy. The gums were lanced, and the pain ceased.

EXPLANATION OF PLATES.

PLATE I.

Fig. 1. A front view of the upper and lower-jaws of an adult, with a full set of teeth. *a a a* the upper-jaw. *b b* the lower-jaw.

Fig. 2. A side view of both jaws in the same state. *a a* the upper-jaw. *b b* the lower-jaw. *c* its ascending process. *d* the root of the coronoid process. *e* the condyle. *f f f f* the fluted alveolar processes.

PLATE II.

Fig. 1. The basis of the upper-jaw, with a full set of teeth, showing the cutting edges and grinding surfaces of the teeth of the upper-jaw. *a a a a* the four incisores. *b b* the two cuspidati. *c c* the four bicuspides. *d d* the six grinders.

Fig. 2. A view from above and behind of the lower-jaw, with a full set of teeth; showing the cutting edges and grinding surfaces of the teeth of that jaw, with the coronoid processes, and condyles for articulation. *a a a a* the four incisores. *b b* the two cuspidati. *c c* the four bicuspides. *d d* the six grinders. *e e* the coronoid processes. *f f* the condyles.

Fig. 3. The moveable cartilage of the joint of the lower-jaw. *a* the cut surface of a longitudinal section of it: the lower and cancave surface is what is articulated with the condyle, the upper and convex surface is what is in contact with the temporal bone.

Fig. 4. A side view of the upper and lower-jaw, in which the outer plate of the alveolar process was taken off to expose the fangs of the teeth in their sockets. The length of each fang is at once seen with respect to its neighbour, and this kind of articulation pointed out at one view.

PLATE III.

Fig. 1. Two views of the sixteen teeth of one side of both jaws, taken out of their sockets to expose the whole of each tooth.

Row 1. The teeth of the upper-jaw, seen from the outside.

Row 2. The same view of the teeth of the lower-jaw: the five single are similar to those of the upper-jaw, but the grinders in this have only two fangs. *a* the incisors. *b* the cuspidati. *c c* the bicuspides. *d d*

the two first grinders, having three fangs. *e* the third grinder, or dens sapientiæ, having also three fangs.

Row 3 & 4. A side view of the same teeth, showing that the incisores and cuspidati, in this view, differ from the former view more than the bicuspides or grinders.

Row 3. *a a* the two incisores of the upper-jaw, showing the hollowed inner surface of the body of these teeth. *b* the cuspidatus, showing the same. *c c* the bicuspides, showing the two points at the basis of each. The first of them has a forked fang.

Fig. 1—7. Show the cavities of the teeth in the incisores, cuspidatus, bicuspidatus and molares.

Fig. 8. A molaris of the lower-jaw, with part of its fangs sawed off, to show that the sides of the cavity or canal have grown together, and divided it into two small canals, which are represented by the four dark points.

Fig. 9—10. The cavity in the body of the teeth seen in transverse sections.

Fig. 11—12. Longitudinal sections of the molares to expose the cavities.

Fig. 13. The basis of a molaris whose points were worn down, and the bony part which projected into those points exposed.

Fig. 14. A molaris whose bony part is wholly exposed, and only a circle of enamel left, covering the sides all round.

Fig. 15—16. A lateral view of the enamel of a molaris and bicuspis, cut longitudinally.

Fig. 17. A cuspidatus worn so much down as to expose the whole end of the bony part, a circle only of enamel remaining.

Fig. 18. An incisor slit down its axis, to show the enamel upon the body of the tooth, covering much more of the convex than of the concave part.

Fig. 19. An incisor, showing the same as fig. 17.

Fig. 20. A horse's tooth slit down its whole length, to show how the enamel is intermixed with the bony part, and that it passes through the whole length of the tooth. The enamel is presented by the white lines, which are penniform, showing the striated texture of the enamel.

Fig. 21. The grinding surface of a horse's molaris, to show the irregular course of the enamel.

Fig. 22. An incisor a little magnified, slit down its middle, to show that the enamel is striated, and that the striæ are turned towards the centre.

Fig. 23. A grinder in the same state, to show the same circumstances.

Fig. 24. The basis of a molaris broken through, showing that the enamel is striated in this view also, and that the striæ point to the centre. N.B. The teeth must be broken to show these facts.

Fig. 25. An old tooth, whose basis has been worn down below the original termination of the cavity in the body of the tooth, and that end has been filled up, in the same proportion with new matter, to prevent the cavity being exposed. This matter is of a darker colour, as represented in the figure.

Fig. 26. Another tooth in the same state.

PLATE IV.

Fig. 1. One side of the upper and lower-jaw of a subject about eight or nine years of age, where the incisores and cuspidati of the fœtus were shed, and their successors rising in new sockets; showing likewise the two grinders of the child, with the bicuspides forming underneath. The adult grinder was ready to cut the gum; and the second grinder of the lower-jaw is lodged in the root of the coronoid process, and in the upper-jaw it is in the tubercle.

Fig. 2. Part of the lower-jaw cut through at the symphysis. The incisor of the child is standing in its socket, and the adult incisor forming in a distinct socket underneath.

Fig. 3. Another view of the same piece of the jaw, to show that the bicuspides are formed in distinct sockets of their own, and not in the socket of the grinder which stands above.

PLATE V.

Fig. 1—2. The lower and upper-jaw of a fœtus, from which part of the gum and bony socket is taken off, to expose the membrane which incloses the teeth.

Fig. 3. The lower-jaw of a new-born child, where this inclosing membrane is opened, to show the bodies of the teeth which were covered by it. The blood-vessels which run in its substance are also exposed.

Fig. 4. That part of the jaw and gum which contains the cuspidatus: the whole is a little magnified. The membrane is opened and turned off on each side, and the fore-part is turned down: the upper part of the pulp is covered with its bony shell, which is seen by its want of vessels.

Fig. 5 and 6. The pulp of a cuspidatus, and the pulp of a grinder, magnified. The ossifications are removed to show that the pulps are of the same shape with the teeth which are formed upon them. As far down on the pulp as the vessels are seen, the ossification had advanced; which shows that it is more vascular where the operation of ossification is going on. The lower ragged edges represent the borders of the capsulæ turned down.

Fig. 7. One of the grinders of the lower-jaw, sawed down to expose the two cavities or canals leading to the body of the tooth, where they unite and form a square cavity. In these two canals are seen two arteries, which run on to the common cavity, and there ramify. The veins are not injected. The whole is magnified. In the body of the tooth may be observed a number of strata, each of which is lost in the circumference of the tooth.

Fig. 8. An incisor prepared and magnified in the same manner, showing the same circumstances in that tooth.

Fig. 9. The production of the permanent rudiment by means of a process given off from the temporary, shown in a lower incisor.

Fig. 10. The rudiments in a more advanced stage; the permanent being now inclosed in its proper socket, though still connected with the temporary.

Fig. 11. The connection between the temporary tooth and the permanent rudiment, as it exists after the former has passed through the gum.

Fig. 12. A view of the lower-jaw, after the whole temporary teeth have passed through the gums, showing the relative position of the temporary teeth, and the rudiments of the permanent at this period.

Fig. 13. Shows the formation and cavity of the fangs of the molares. The upper row are those of the lower-jaw, and the lower those of the upper. A A, *a a* is the common cavity in the body of the tooth; which in the second, *a a*, is deeper than in the first. B shows the bony arch thrown over the mouth of the cavity, and dividing that into two openings, which give origin to the two fangs. C D D the progress of these fangs. F a molaris of the upper-jaw, where the mouth of the cavity is a little tucked in, at three different points from which three ossifications shoot. G shows these ossifications, and the beginning of these fangs. H I K show the gradual growth of these fangs.

Fig. 14. Is a comparative view of the incisors and grinders of the child and adult; for the better understanding of which they are sawed down the middle, showing, in a side view, the gradual increase of these teeth. The uppermost row is of the child, and the lower of the adult. *a b c d* show the gradual growth of the body, fangs and cavity of the incisors of both ages. *e f g* show these circumstances in the grinders.

Fig. 15. 1—7 show the gradual growth of a single tooth, from its formation nearly, to its being almost complete.

Fig. 16. A series of grinders of the child, from their being complete, to their utmost decay. *a* is a grinder of the upper-jaw nearly complete, in which the three fangs are almost formed. *b* has some of its fang absorbed. *c* more. *d* still more. *e* nearly all gone, and *f* the whole of the fangs gone, only the neck and body remaining.

Fig. 17. A series of incisors in the same state. No. 1. a completely formed tooth; 2, the fang somewhat decayed; 3, more so; 4, still more; 5, The fang almost gone; and 6, the whole fang gone, the neck and body only remaining.

Fig. 18. A horse's tooth that was just ready to be shed. The three parts of the tooth, which stand up, inclosed the rising end of the young tooth. This is all that was left of a long tooth.

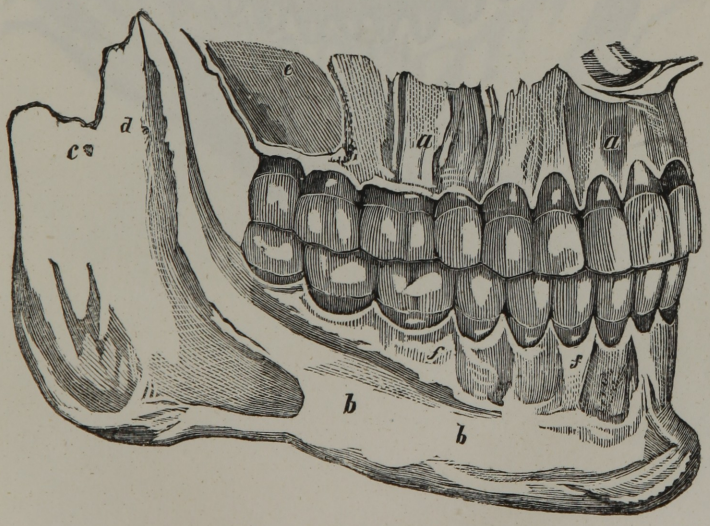
PLATES

TO

HUNTER ON THE HUMAN TEETH.

PLATE I.

Fig. 1.



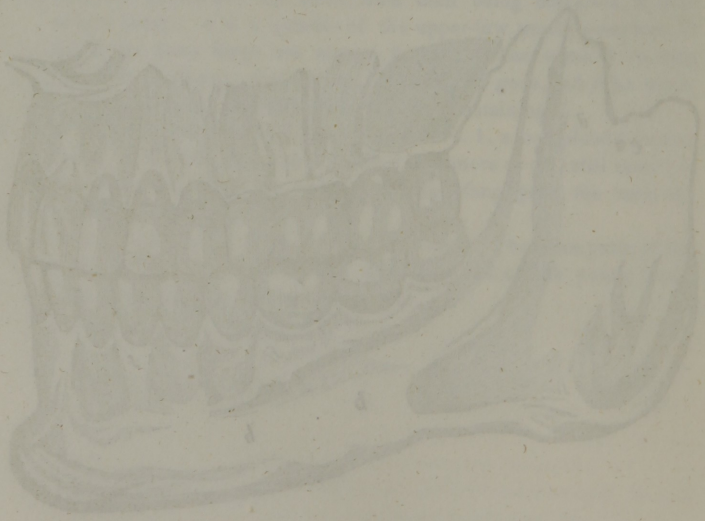
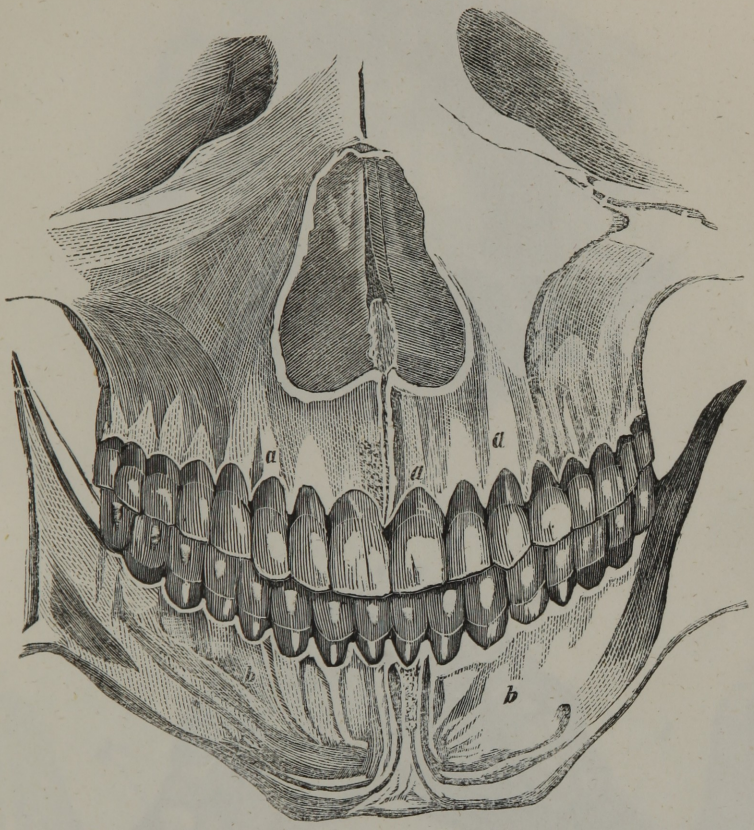


Fig. 2. PLATE I.



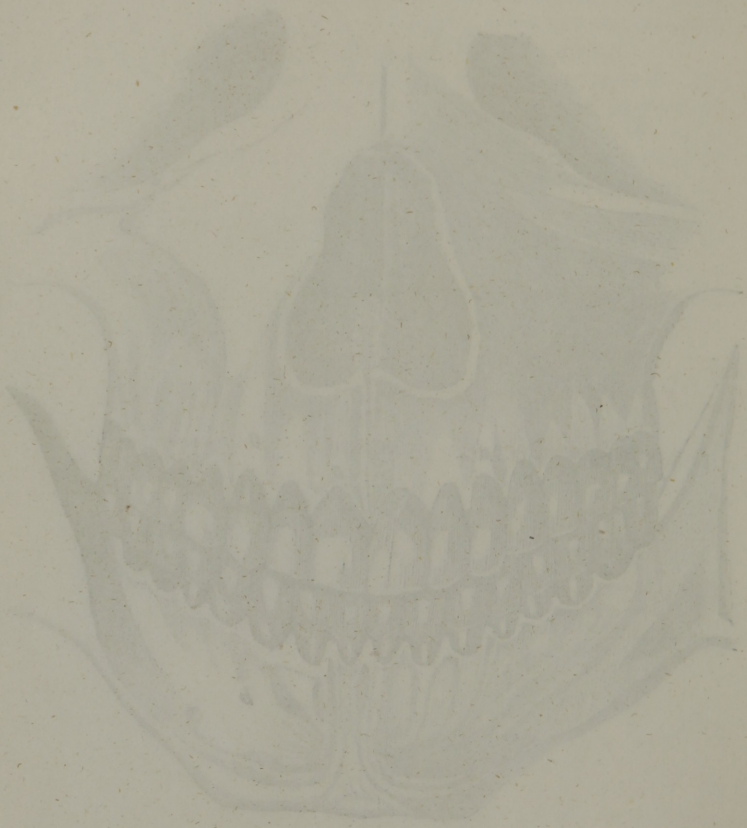


PLATE II.

Fig. 1.

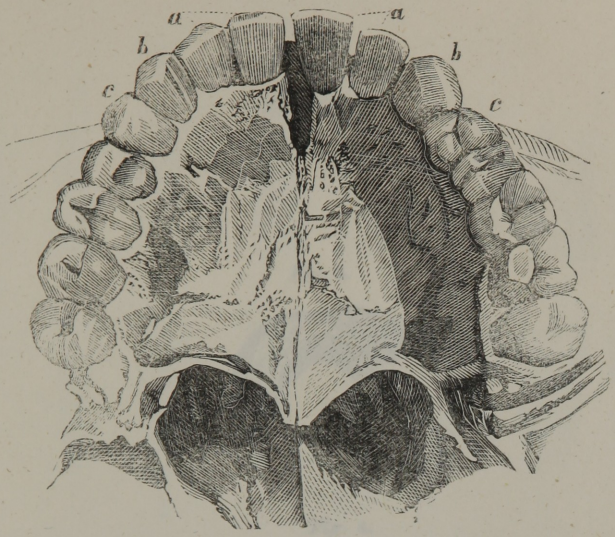
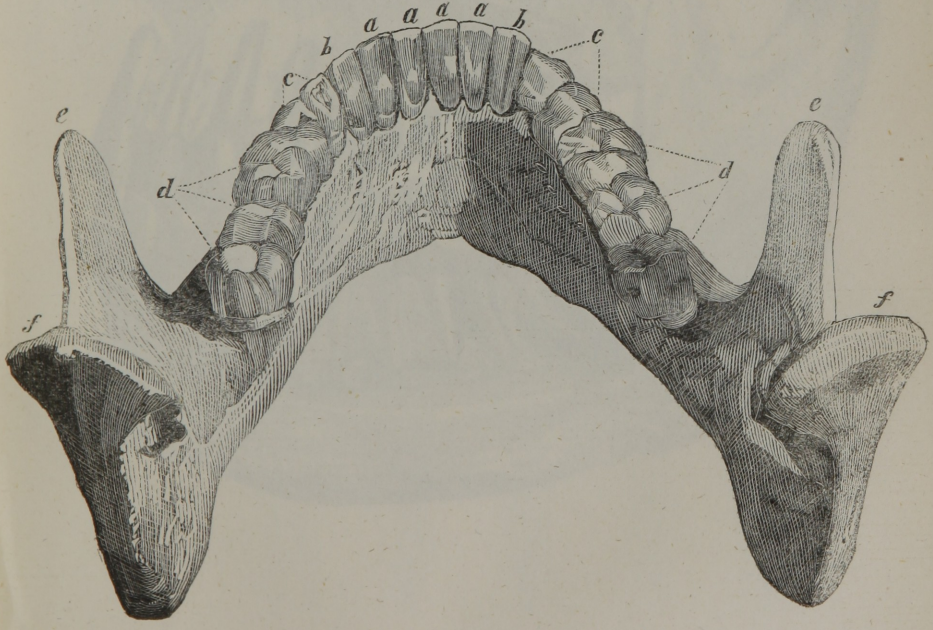


Fig. 2.



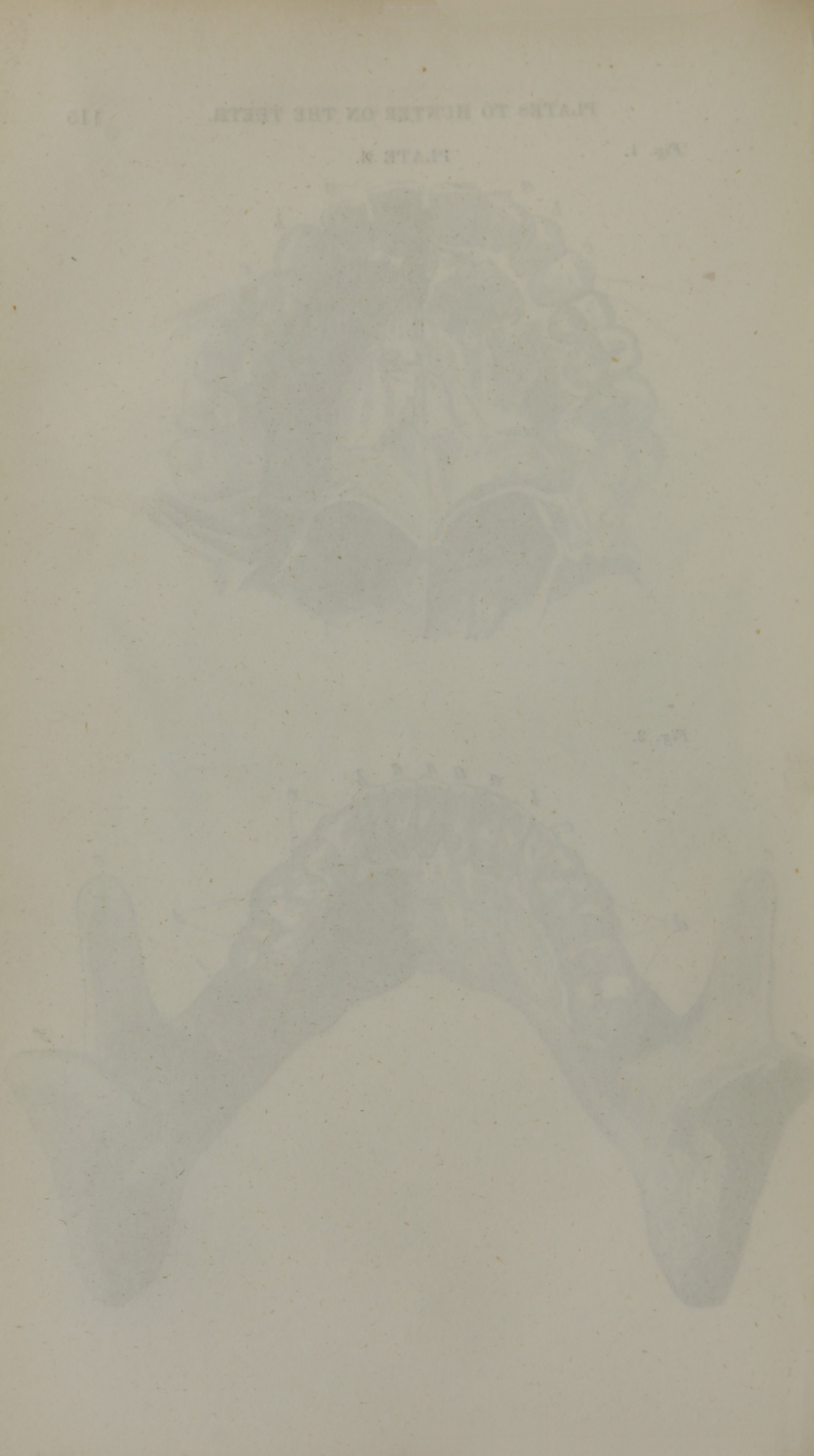
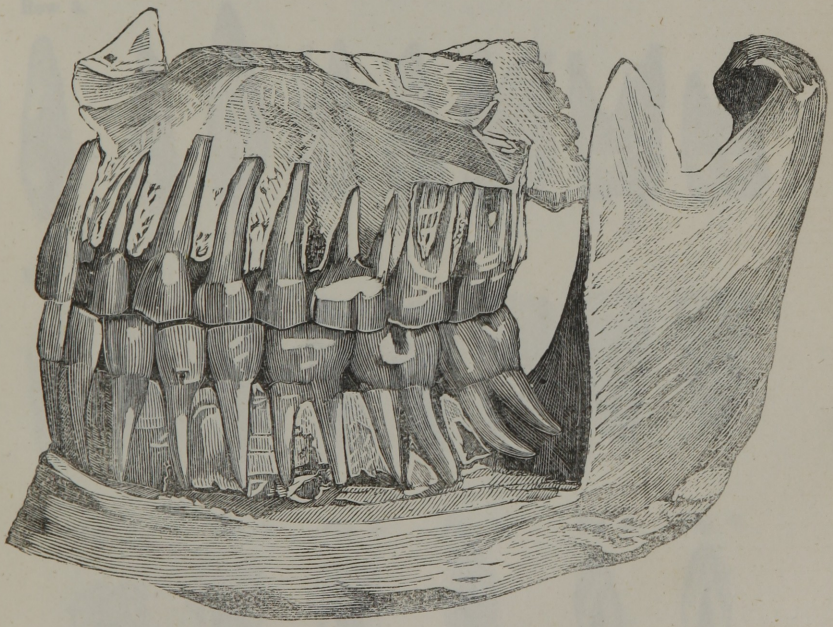


PLATE II.

Fig. 3.

Fig. 4.



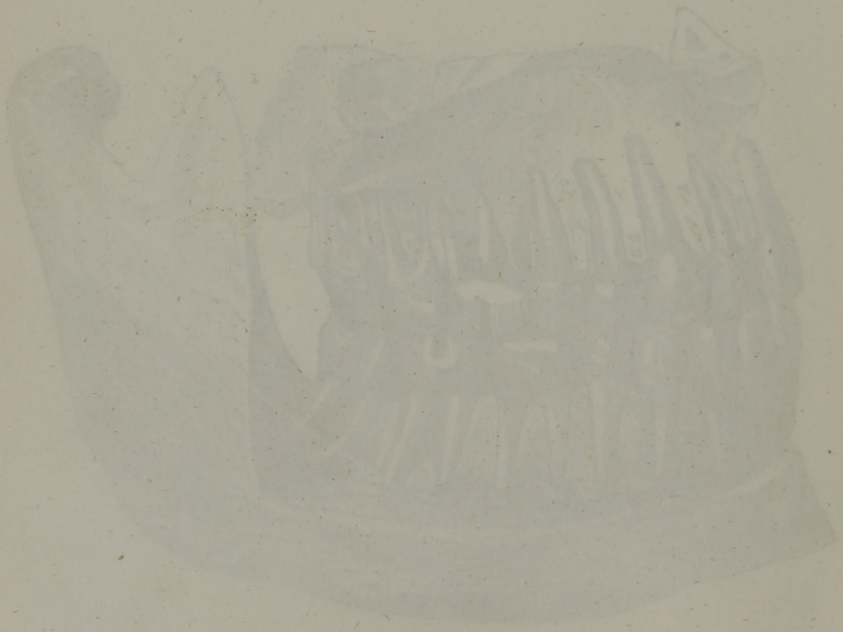
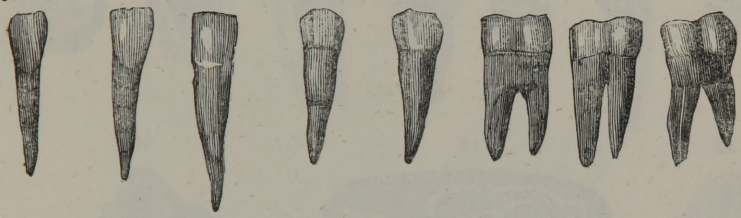


PLATE III.

Row 1. *Fig.* 1.

a *b* *c* *c* *d* *d* *e*

Row 2.



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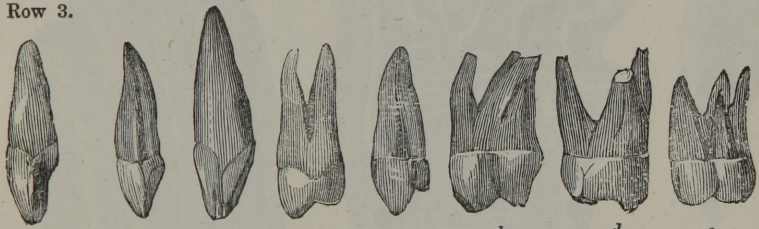


a *a* *b* *c* *c* *d* *d* *e*

Row 4.

Fig. 2. *Fig.* 3. *Fig.* 4. *Fig.* 5. *Fig.* 6. *Fig.* 7.

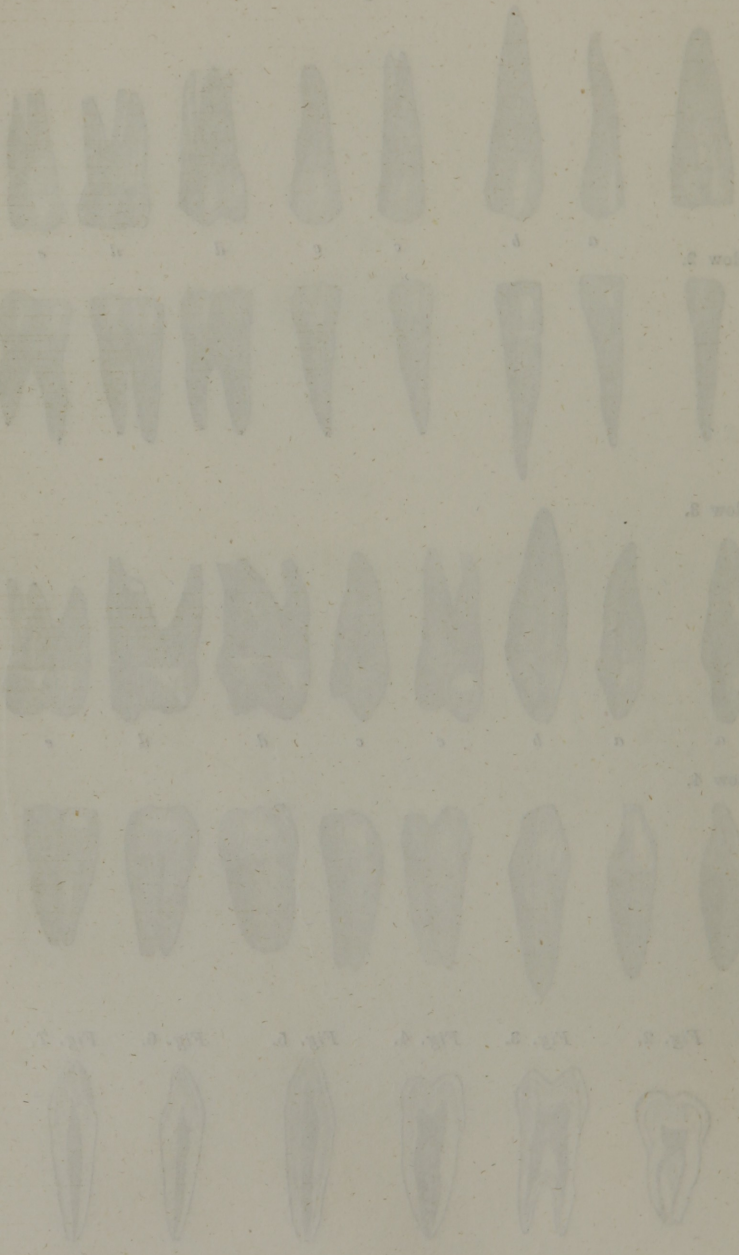
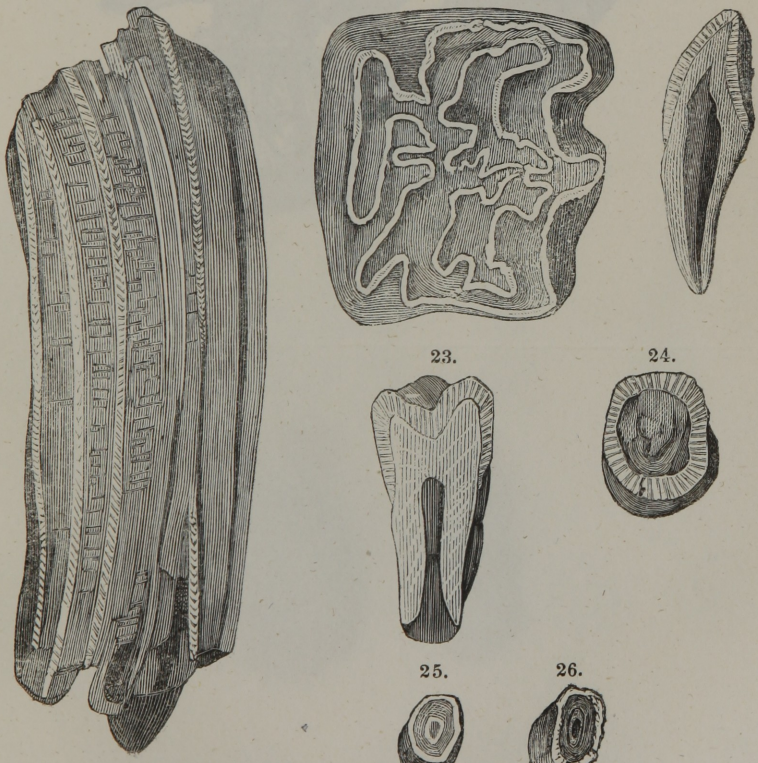


PLATE III.

Fig. 8. 9. 10. 11. 12.

13. 14. 15. 16. 17. 18. 19.

20. 21. 22.



23. 24.

25. 26.

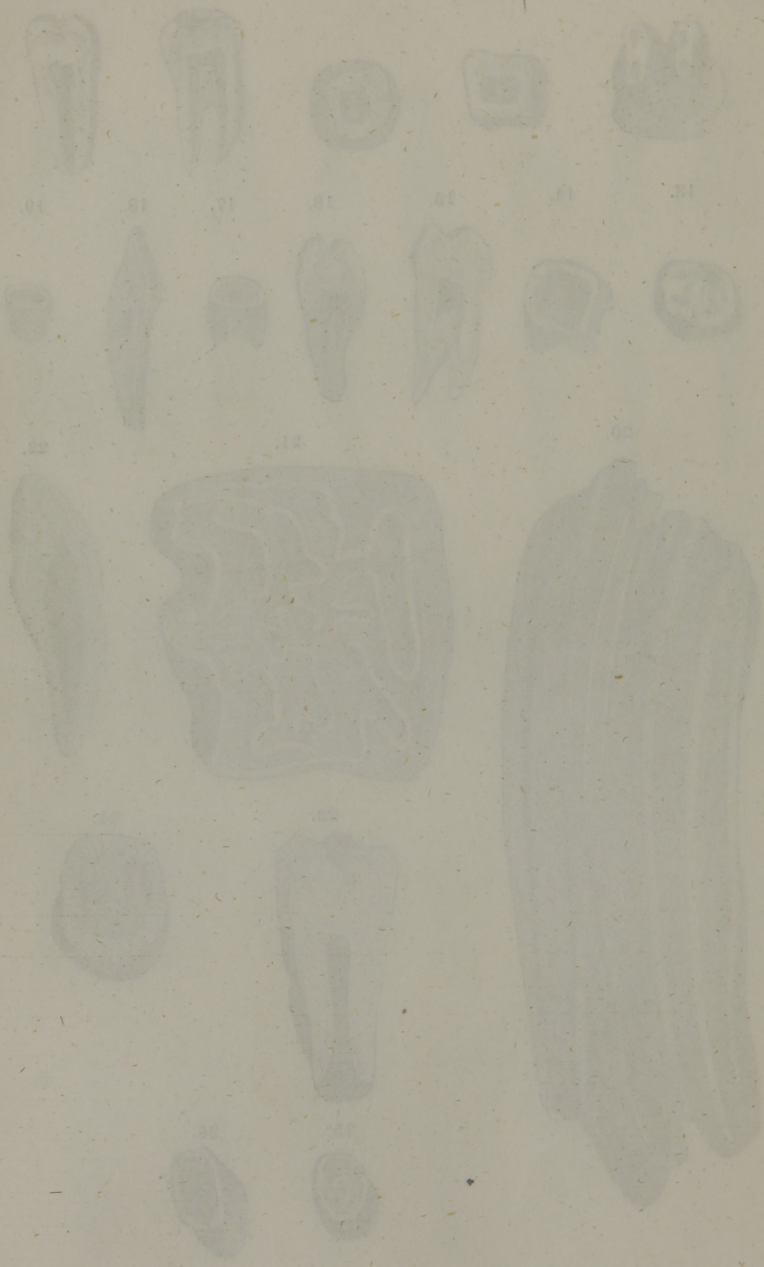
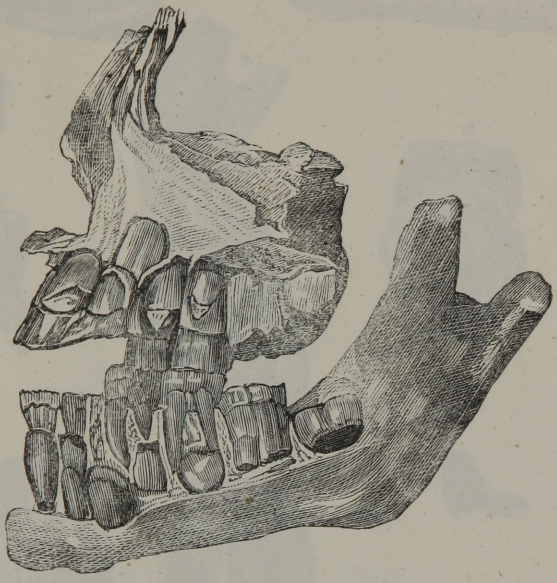


PLATE IV.

Fig. 1.



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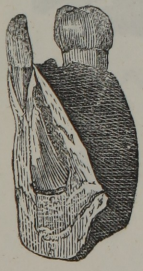

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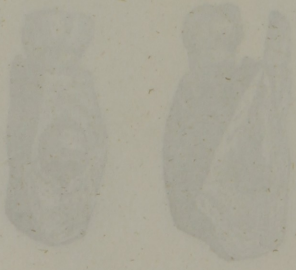


PLATE V. *Fig.* 1.

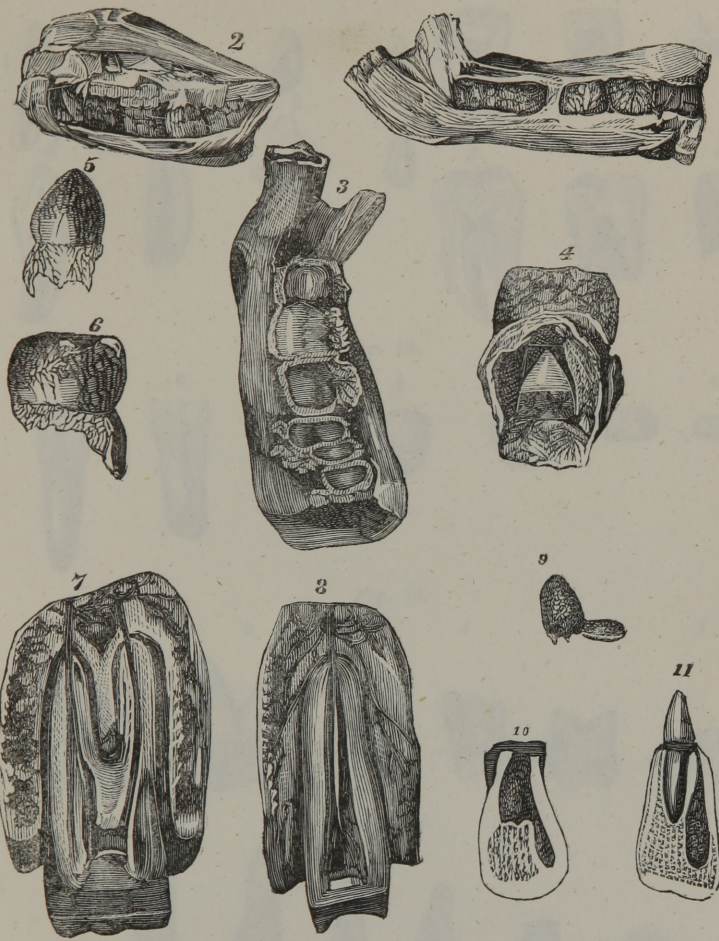
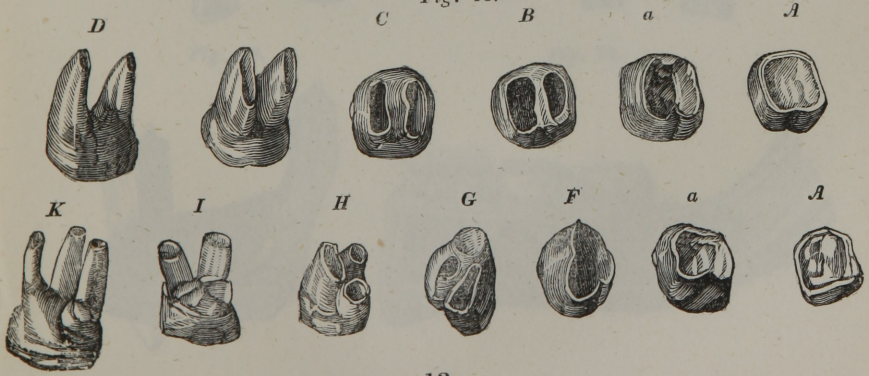


Fig. 13.



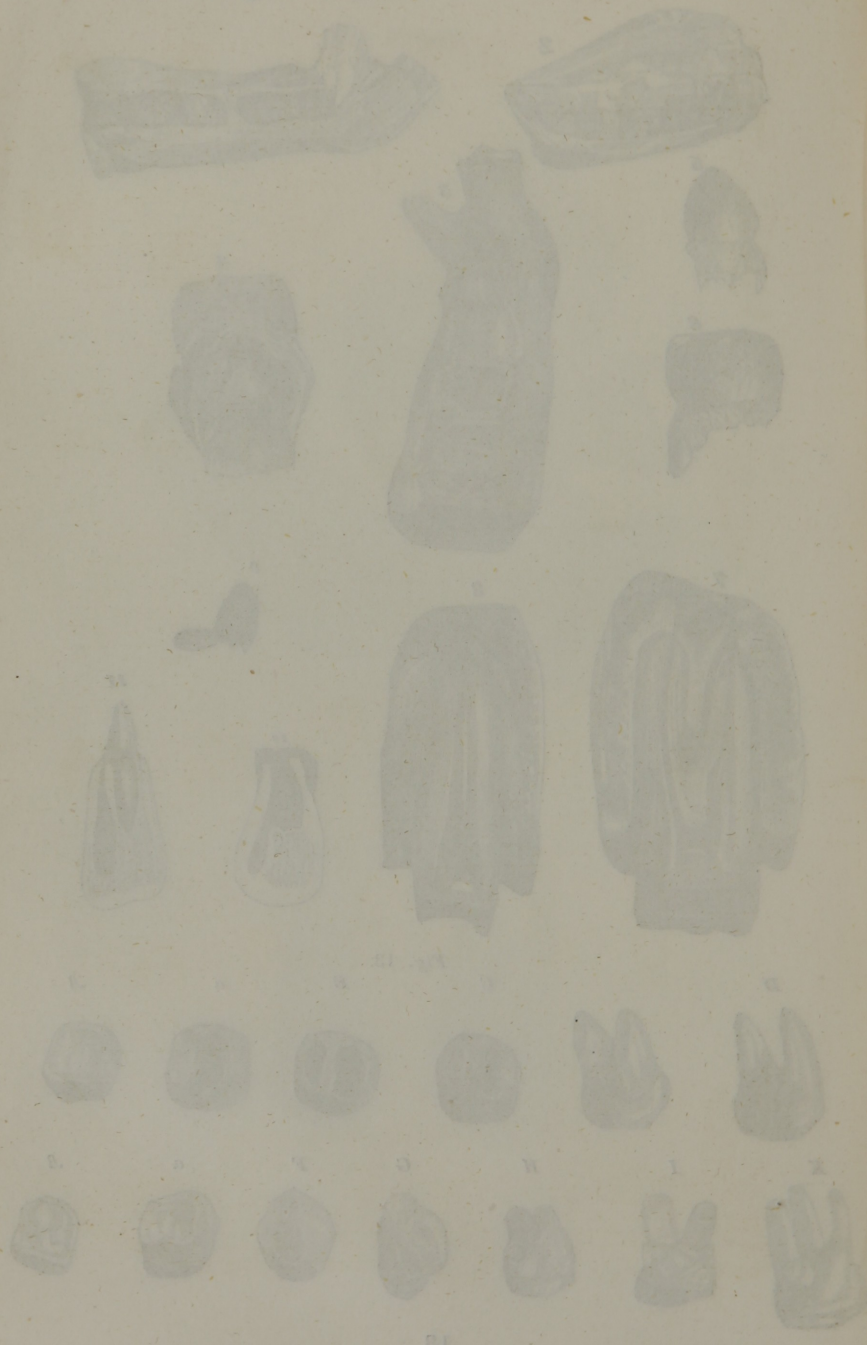


Fig. 14.

PLATE V.

Fig. 15.

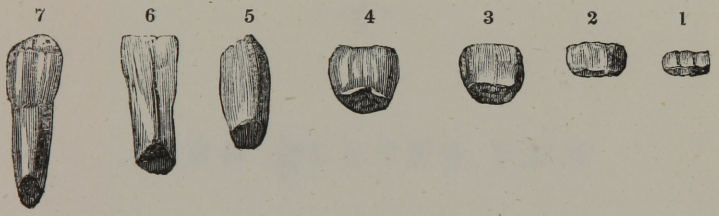


Fig. 16.

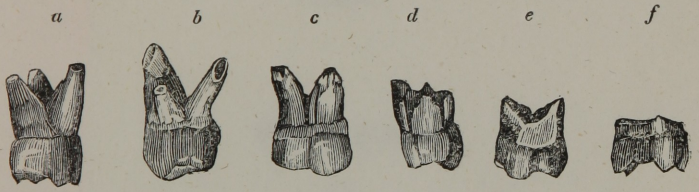


Fig. 17.

Fig. 18.

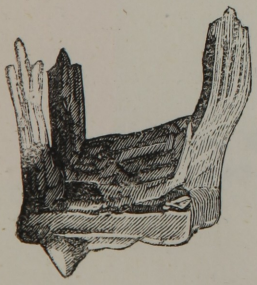


Fig. 12.