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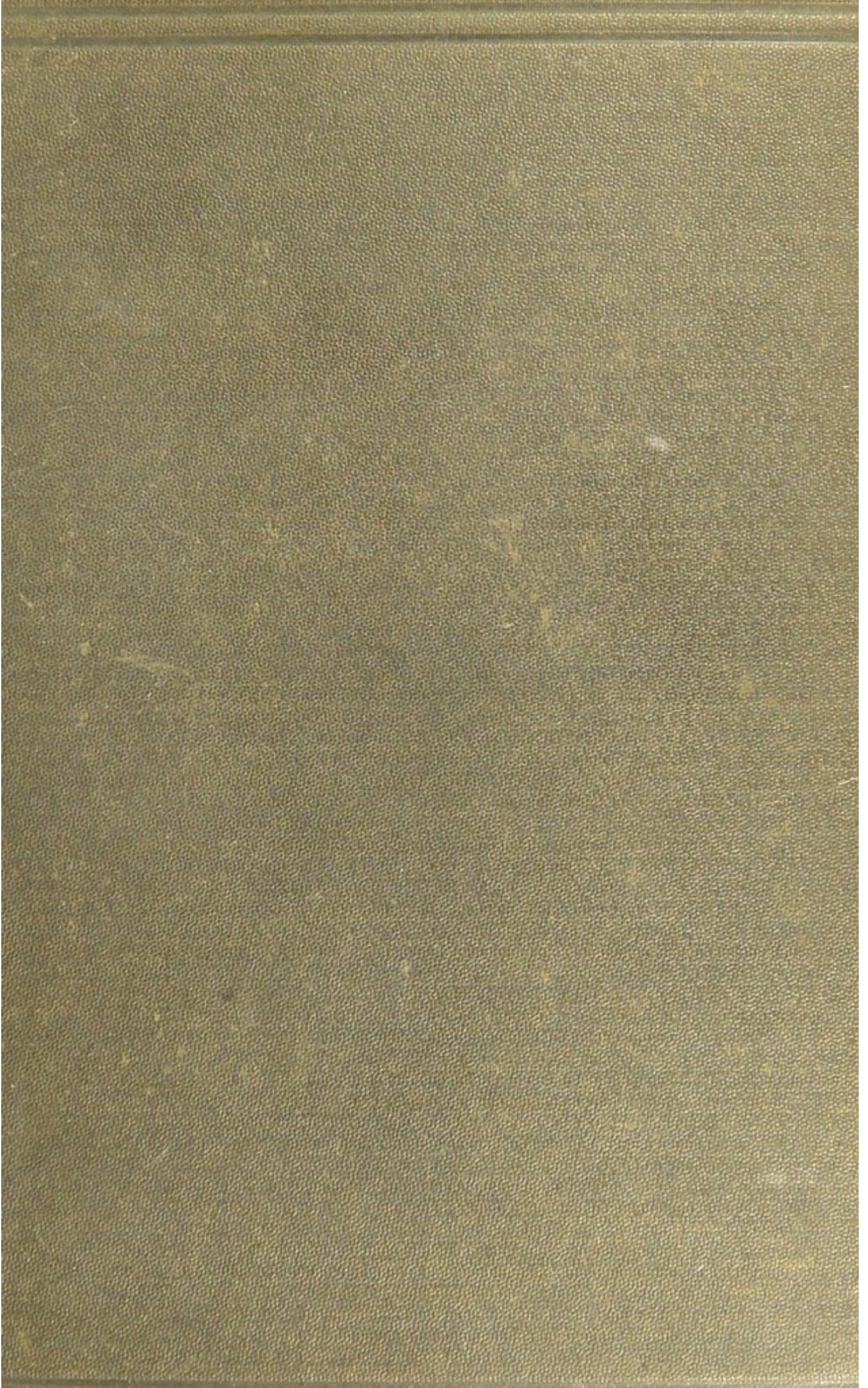
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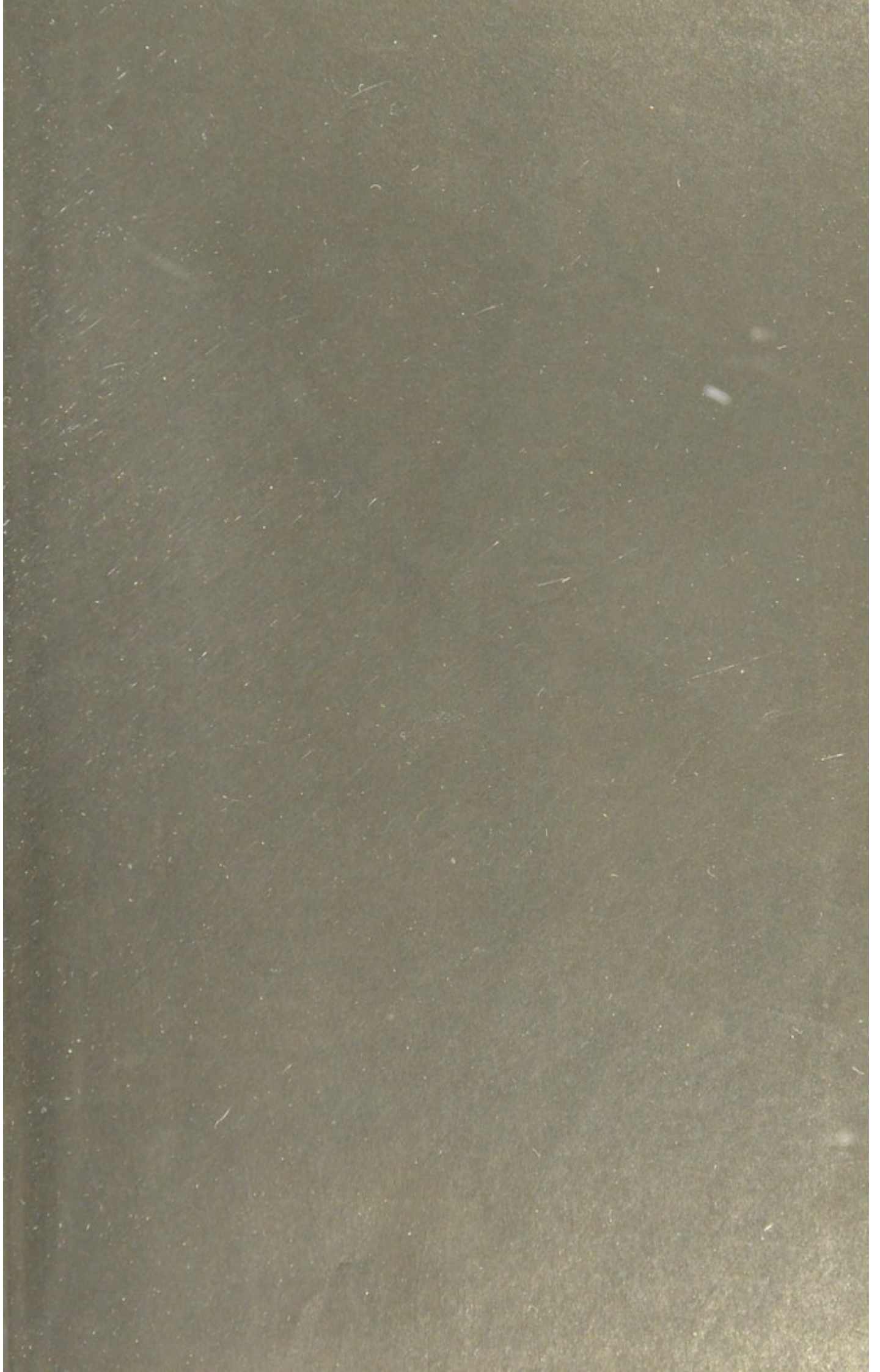
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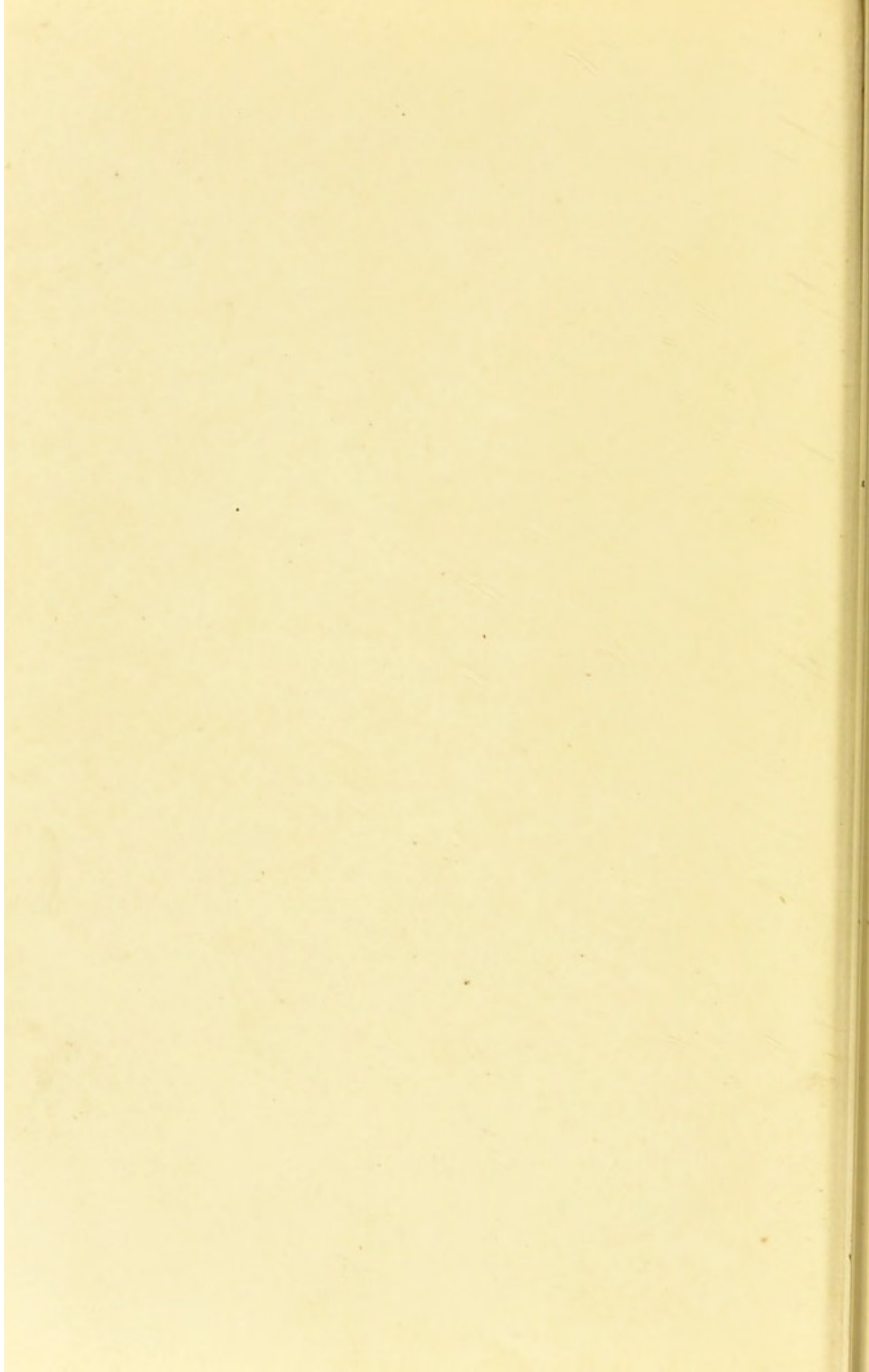


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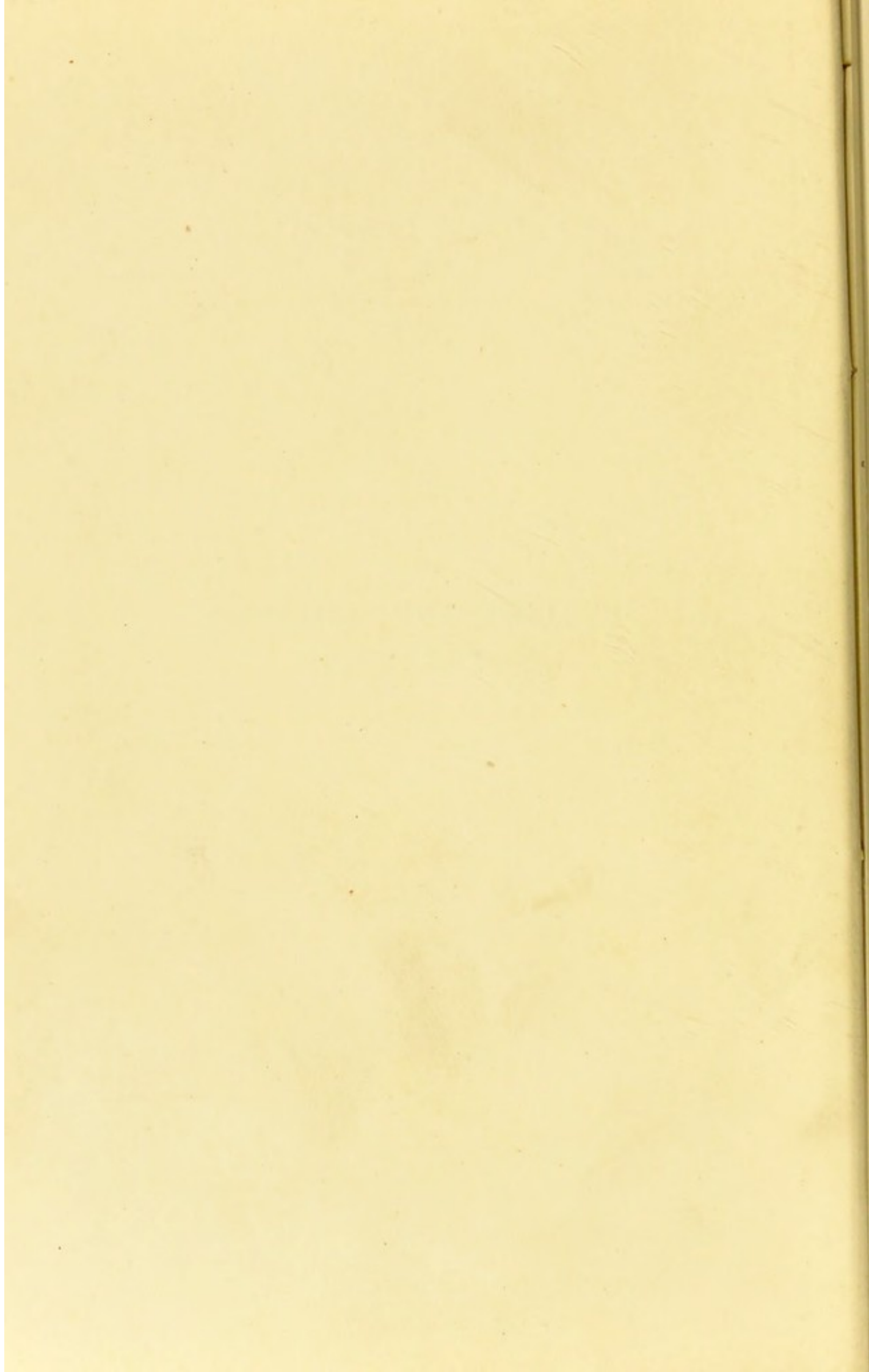
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DISEASES AND INJURIES
OF THE TEETH



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DISEASES AND INJURIES OF THE TEETH

INCLUDING

PATHOLOGY AND TREATMENT

*A MANUAL OF PRACTICAL DENTISTRY FOR
STUDENTS AND PRACTITIONERS.*

BY

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PREFACE.

THE present volume was originally undertaken at the instance of the publishers, whose request was perhaps acceded to the more readily as it had been preferred not a few times by students, and because the authors have ventured to believe that a long experience in hospital work, as well as in actual teaching, may invest their writing with some value for the student and practitioner.

In compiling this manual, while an effort has been made to enunciate succinctly and plainly the principles underlying the art of Dental Surgery, yet in no case have the practical bearings of the subject been permitted to be overlooked, and it is hoped in its present form not only will dental students but general practitioners in medicine be able to follow its descriptions and directions with ease and profit. In accordance with the nomenclature adopted in a recent authoritative treatise on Anatomy, edited by Henry Morris, the following terms have been adopted:—Mandible for inferior maxilla, maxilla being restricted to the upper jaw; temporo-mandibular articulation for temporo-maxillary joint; stylo-mandibular ligament, mandibular artery and nerve respectively for the stylo-maxillary ligament and inferior dental artery and nerve.

Among omissions which it has been thought advisable to make, the subject of the adaptation of artificial crowns and that of bridge work have been left untouched, as they are fully dealt with in books specially bearing upon the subject.

The illustrations, which have purposely been made very

numerous to render the descriptions clearer, are for the most part original. Some have, however, been borrowed from the works of Coleman, Heath, Miller, and Wedl. We have also to express our obligation for the loan of blocks to the Council of the Odontological Society of Great Britain, to the publishers of *The American System of Dental Surgery*, and to Messrs. Claudius Ash & Sons. In connection with the original illustrations, we have to express gratitude to Mr. Hopewell Smith for his skilful drawings of many of the microscopic sections, to Mr. Stanley Colyer for photographing the models and specimens from which the illustrations have been taken, to Mr. Phillips for his diagrams illustrating the chapter dealing with the filling of cavities, and to Mr. Danielson for his skill and accuracy in the execution of the woodcuts. To Mr. Mummery and Mr. Pringle we owe the excellent photo-micrographs illustrative of caries. Mr. Caush and Mr. Mummery and the Council of the Students' Society [Dental Hospital of London] have kindly lent us many valuable specimens and microscopic sections. We are greatly indebted to Dr. Dudley Buxton for reading through the proof sheets, and to Mr. Ackery for various valuable suggestions as the book passed through the press.

MORTON SMALE.
J. F. COLYER.

June, 1893.

CONTENTS.

	PAGE
INTRODUCTION,	xi
CHAPTER I.	
FIRST DENTITION,	1
CHAPTER II.	
ABNORMALITIES AND DISEASES OF THE TEMPORARY TEETH,	11
CHAPTER III.	
SECOND DENTITION,	22
CHAPTER IV.	
ABNORMALITIES OF THE PERMANENT TEETH,	31
CHAPTER V.	
CONCUSSION, DISLOCATION, AND FRACTURE OF THE TEETH,	129
CHAPTER VI.	
CARIES,	134
CHAPTER VII.	
TREATMENT OF CARIES,	154

	PAGE
CHAPTER VIII.	
THE DENTAL PULP AND ITS TREATMENT IN HEALTH AND DISEASE,	215
CHAPTER IX.	
DISEASES OF THE DENTAL PERIOSTEUM—INFLAMMATION— EXOSTOSIS—ABSORPTION—NECROSIS—PYORRHŒA ALVEO- LARIS,	250
CHAPTER X.	
EROSION—ATTRITION—ABRASION,	277
CHAPTER XI.	
DISEASES OF THE GUMS AND ADJACENT MUCOUS MEMBRANE, .	286
CHAPTER XII.	
SALIVA AND SALIVARY CALCULUS,	306
CHAPTER XIII.	
ODONTOMES,	312
CHAPTER XIV.	
REPLANTATION, TRANSPLANTATION AND IMPLANTATION OF THE TEETH,	325
CHAPTER XV.	
THE OPERATION OF EXTRACTION OF THE TEETH,	329
CHAPTER XVI.	
ODONTALGIA AND NEURALGIA,	356
CHAPTER XVII.	
FRACTURES OF THE JAWS,	364

CHAPTER XVIII.

	PAGE
NECROSIS OF THE JAWS,	378

CHAPTER XIX.

SUPPURATION (EMPHYÆMA) IN THE ANTRUM,	383
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CHAPTER XX.

TRISMUS—INTERFERENCE WITH THE MOVEMENTS OF THE TEMPORO- MANDIBULAR ARTICULATION,	387
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CHAPTER XXI.

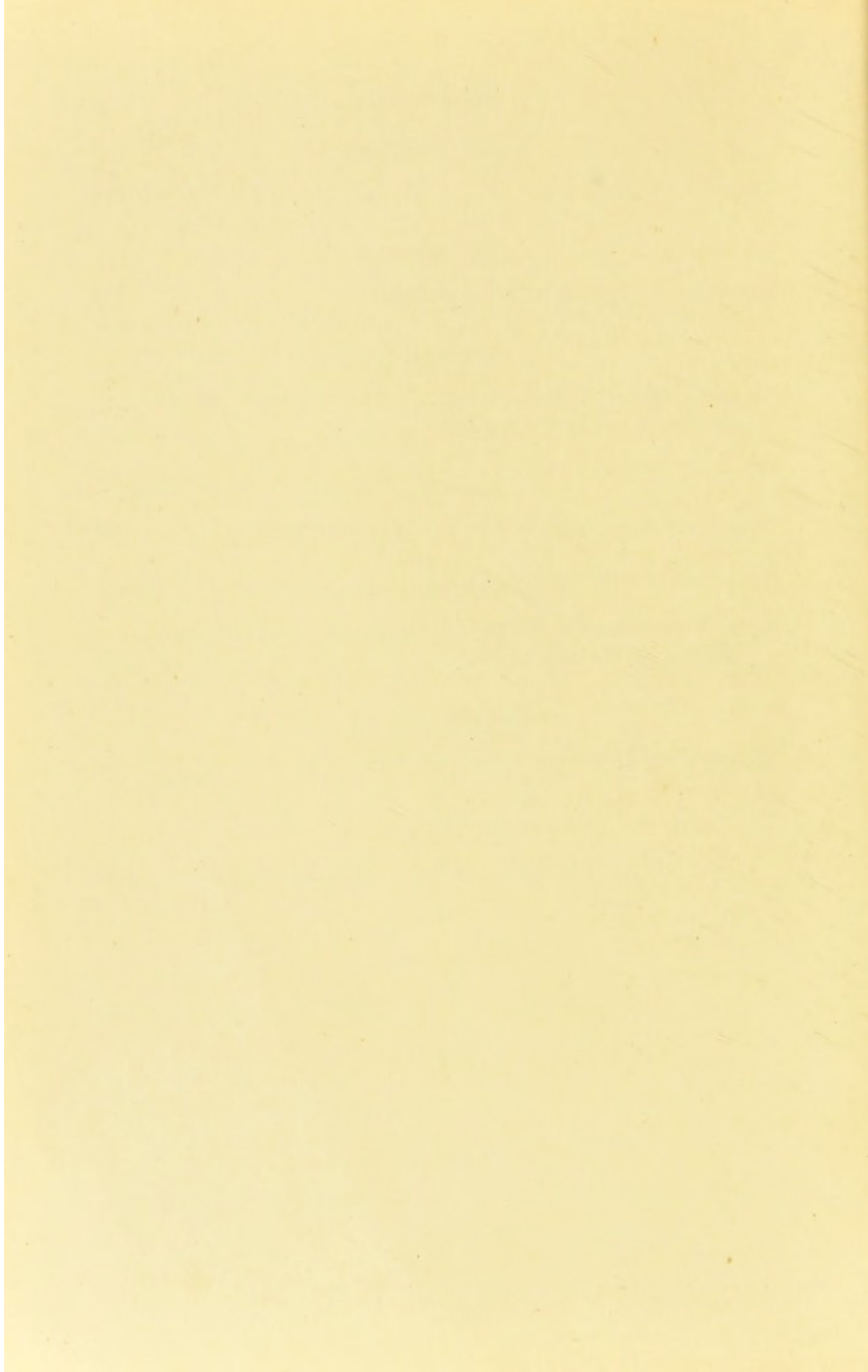
DISEASES DUE TO THE PRESENCE OF DISEASED TEETH,	393
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CHAPTER XXII.

SOME COMMON AFFECTIONS OF THE TONGUE MET WITH IN THE COURSE OF DENTAL PRACTICE,	399
--	-----

CHAPTER XXIII.

DIAGNOSIS OF SWELLINGS ABOUT THE JAWS,	403
--	-----



INTRODUCTION.

IN the consideration of the various pathological changes that may occur in connection with the teeth, there is one which, although it may not be purely pathological, is nevertheless full of interest, not only to the dental surgeon, but also to all scientific workers and to the general public. It is one about which no altogether satisfactory explanation has yet been forthcoming, although many dentists have endeavoured to elucidate it, and much has been written upon it at various times. It is admitted on all hands that, concurrently with increasing civilisation, there has been a degeneracy in the structure of the teeth, which has rendered them less able to resist the ravages of dental caries. It has been proved beyond doubt that caries is produced by external agencies—that it is caused by chemical action and through the instrumentality of micro-organisms; yet, while this is incontestable, those who have worked so ably and well to prove the local cause have not altogether cleared the subject of its difficulties.

It must be within the knowledge of our readers that a very large proportion of the public never come under the inspection of the dental surgeon, because at no time has any one of them suffered from a dental lesion. There are mouths to be met with, both among the poor and also among the rich, free from dental caries, mouths in which the structure and position of the teeth are so perfect that they are able to resist all local causes of caries, and remain throughout life perfect and free from disease; and this, as in the case of the poor, when no cleanliness has been

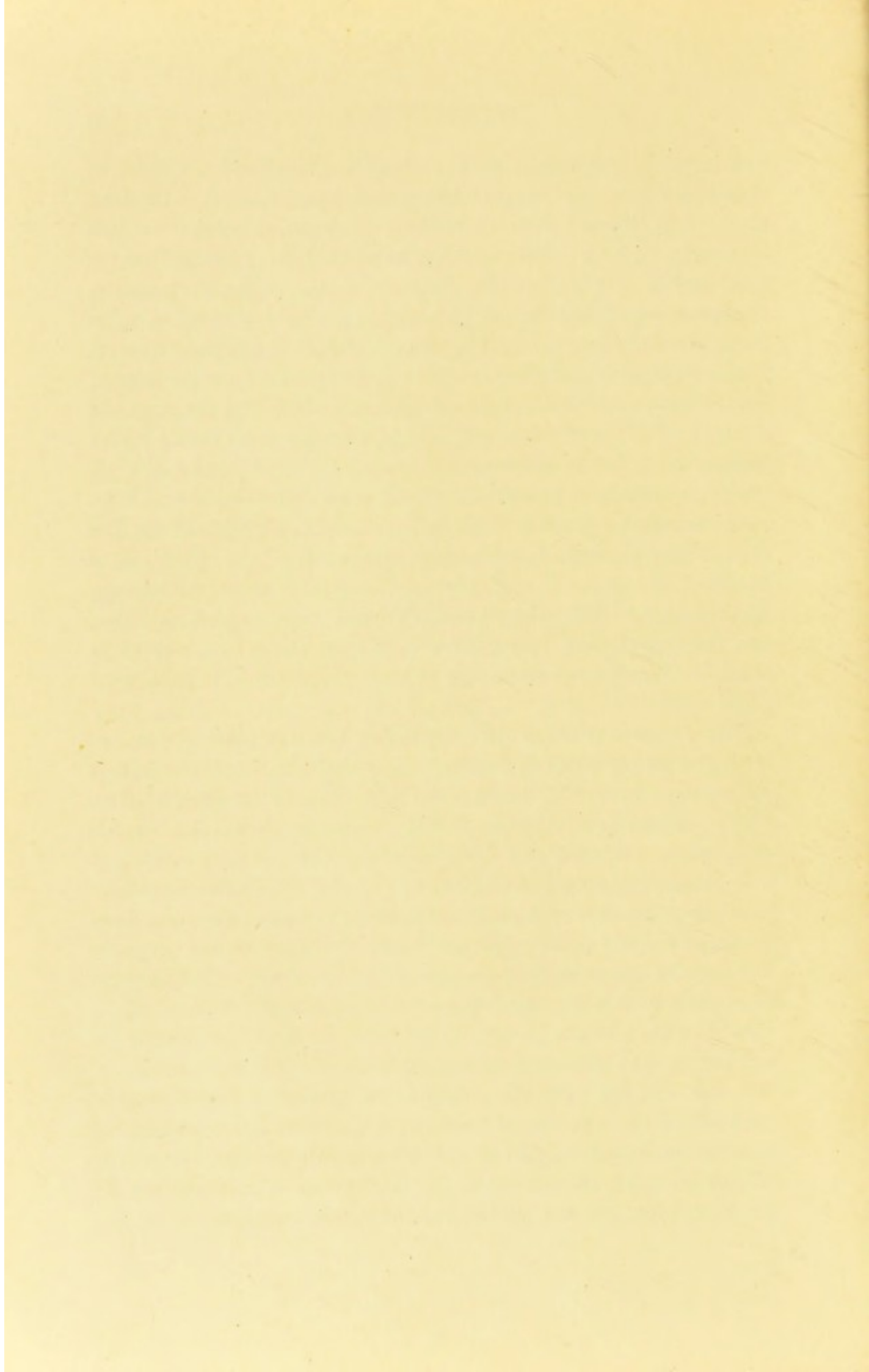
practised. Mouths are seen in adults that have never had a tooth-brush used to the teeth, and which, in spite of all hygienic disabilities, have remained free from decay to the end. It is evident therefore that perfectly developed teeth are capable of resisting both the action of acids as well as the presence of micro-organisms. In endeavouring to elucidate the causes of the degeneracy of the teeth, perhaps the most important factor is heredity, and yet it is not at all uncommon to find parents with strong healthy teeth whose children are afflicted beyond the average in the matter of decayed dental organs. This points to some cause other than that of heredity strictly interpreted, and the *fons et origo mali* must be sought for either in some constitutional taint, or in some faulty development during gestation, or in some errors of diet and hygiene during the early periods of life. If we exclude the first of these three causes, and admit that constitutional diathesis may help to explain the condition we are considering, we have still to account for cases of faulty teeth in children whose parents are, beyond doubt, free from any kind of constitutional trouble. There is no question so frequently asked by the public as, Why are the teeth of the present generation so bad? and no question so difficult to answer with a short definition of the cause. While it is asked in many cases from mere idle curiosity, without any real desire for knowledge, the dental surgeon may well take the opportunity to give words of warning to his patient, particularly when the questioner is likely to become a mother, and it would be well for him to persuade his medical friends of the truth of the proposition that the teeth of the future depend upon the mothers of the future, the responsibility of maternity being very great in this direction.

The treatment of our patients, both in private and at hospital, is a subject that may be considered with advantage.

It cannot be too strongly insisted upon, that, in either case, the very best we can do should be at the disposal of our patients. Professional men are not selling materials to their clients for which they are to receive a price that shall bear a profit more or

less large in proportion to the trouble that has been used in obtaining them, without any thought as to whether it is the best that can be offered to their customer. A patient comes to him ignorant of his art, desiring that he should do the very best for him, and it is the dentist's duty so to do. The fact that a dentist is practising means that he is offering his services upon these conditions, and anything short of that is malpractice. It is the duty of the student, therefore, during his hospital days to devote himself with energy and determination to mastering the minutiae of his profession, not, in the first instance, that he may make money, but in order that he may be of service to mankind, which is the most honourable of all work, the reward which he may receive for such service being an acknowledgment on the part of the patient of the service he has received, which, it so happens, for general convenience, takes the shape of money. Ruskin says, "The stipend is a due and necessary adjunct, but not the object, of his life, if he be a true clergyman, any more than his fee (or honorarium) is the object of life to a true physician."

The question of fee is always a difficult one to write about, but it cannot be too strongly insisted upon that the dental surgeon is not selling materials, whether for operative or mechanical dentistry; whatever fee he may elect to name should be for his skill and experience, and the idea that when the sum named is more than the patient can afford an inferior article can be substituted should be for ever abolished from our system; the same laws must govern our calling that are found to obtain among surgeons if we are to attain to the true professional position. The surgeon does his best whether he takes a large or a small fee, and if he considers his services of more value than the small fee offered, he refuses to take the case, and recommends a junior practitioner. At once and for ever the principle of arranging fees upon the question of the number of teeth in a denture, and whether the same are mounted on gold or vulcanite, or whether gold or plastic fillings are used, should cease, for this system is good neither for the profession, nor the public, nor the dental surgeon.



DISEASES AND INJURIES OF THE TEETH.

CHAPTER I.

FIRST DENTITION.

THE first subject that should be dealt with in any book on Dental Surgery is the various phenomena which are attendant upon and arise from dentition.

The various tissues of which a tooth is composed are enamel, dentine, cementum, and pulp, and it is well to remember the structures from which these are developed; thus the enamel is formed from the epiblast, the dentine, cementum, and the pulp (with the exception of its nerve filaments) from the mesoblast. These embryonic tissues are affected by various constitutional diatheses in the parents, and thus arise a variety of lesions influencing the teeth during the period of their development.

Before considering this subject, it will be convenient to enumerate the dates at which the germs of the deciduous teeth are formed, and also the periods at which calcification commences. They are as follows:—The enamel organs of the central, lateral, canine, first and second molars, appear in succession during the seventh week of foetal life, their respective dentine bulbs during the ninth week. The calcification of the central and lateral incisors and canines commences at the seventeenth week of embryonic life, that of the first and second molars a week later;

the gradual calcification of these is well shown in fig. 1. In children with constitutional diatheses these dates are only approximately true, and extreme variations from this normal

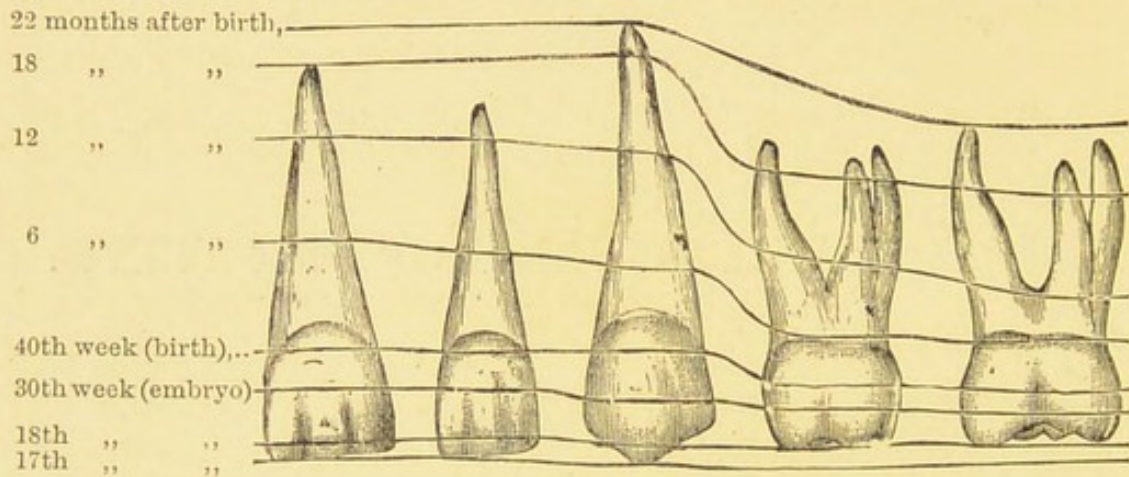


FIG. 1. From *The American System of Dental Surgery*.

condition are seen in strumous, syphilitic, and rickety children. The effects of such diatheses will be referred to subsequently.

Dentition is best considered under two heads—the first or primary, and the second or permanent. In this chapter we propose to deal with the former. The subject of teething in children is one of which it is not desirable to treat at any great length in a manual on Dental Surgery. It has been already exhaustively dealt with in works on the diseases peculiar to infancy and childhood, and we would refer any readers who may be specially interested in this subject to such authors as Drs. West, Eustace Smith, and Lewis. The dental surgeon seldom sees these cases, for, if the trouble be slight, the mother is generally able to deal with it, while the more severe forms, either local or constitutional, come under the care of the general practitioner.

The normal signs of approaching eruption are an increased flow of saliva and a tendency on the part of the child to bite. The mouth is generally hot, the gums tumid, tense, and shining, and the position of the tooth marked by a prominence of gum. This is gradually absorbed, and the tooth makes its appearance. To local signs may be added slight irritability, restlessness, and a rise of temperature, which is usually higher in the morning than

in the evening. Many healthy children pass through this period without any untoward symptoms; but many succumb, as may be gathered from the tables of mortality, teething being the cause of over 4·8 per cent. of deaths in children under twelve months, and 7·8 per cent. between the ages of one and three years.

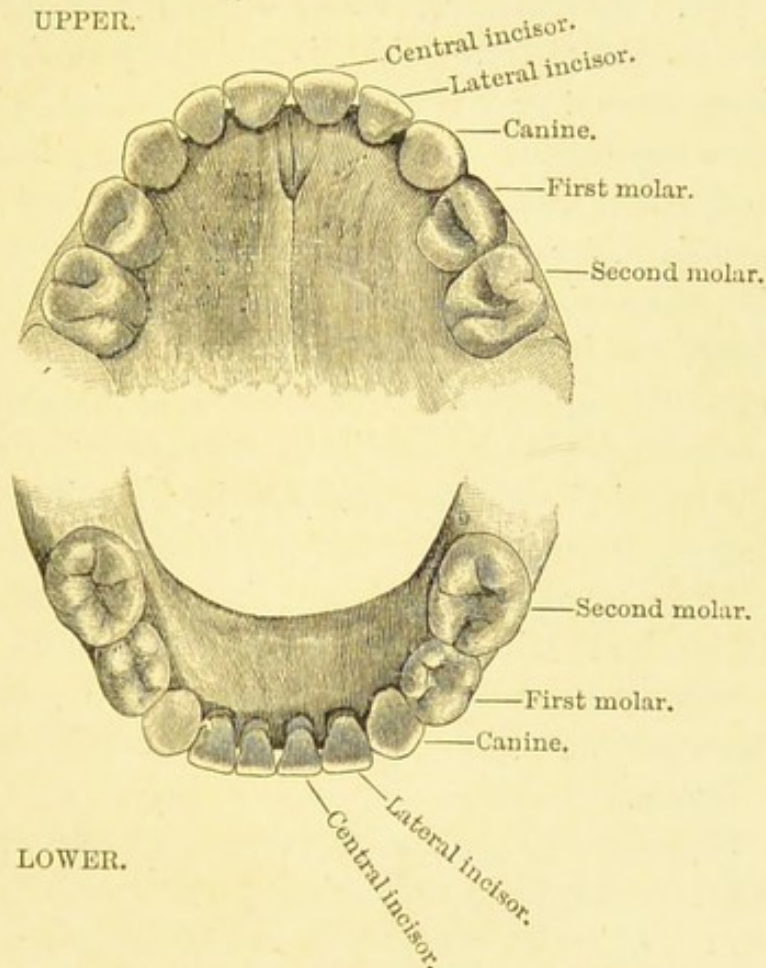


FIG. 2. Represents a fully-developed set of temporary teeth.

The teeth composing the temporary set are twenty in number, and comprise in each jaw four incisors, two canines, and four molars; the dates of their eruption are as follows:—

	Months after birth	Eruption occupying as a rule
Lower central incisors,	7	1 to 10 weeks.
Upper centrals,	9	4 to 6 ,,
Upper and lower laterals,	12	4 to 6 ,,
First molars,	14	1 to 2 months.
Canines,	18	2 to 3 ,,
Second molars,	26	3 to 5 ,,

It will be seen that the teeth erupt in groups, and that between each period of eruption there is a definite pause, which is a beneficial arrangement so far as the child is concerned, allowing for the recuperative powers of the subject to counteract the somewhat exhausting condition brought about by the process of eruption. Mr. Coleman records a case "of a male child who, having lost its mother at birth, did fairly well up to the usual period of teething, when tooth after tooth, irrespective of group, rapidly made its appearance . . . and it gradually lost strength from day to day and week to week until it finally sank exhausted."¹

There is no doubt that in weakly children the process of teething may give rise to various local and constitutional disturbances, but it is doubtful whether it should ever be assigned as the cause of serious trouble leading to death. The more important of the local complications are:—

(1) *Acute inflammation*, characterised by intense redness and swelling of the gums, the mouth at the same time being hot, the child fractious, restless, and in evident pain, which is increased on the patient being placed in the horizontal position. The temperature may reach 104° F. or 105° F., but it should be remembered that pyrexia in children readily supervenes upon slight causes.

(2) *Odontitis infantum*.—In these cases the gums become extremely hot, swollen, and painful, and specially marked over a certain tooth, giving the appearance of a little tumour. Ulceration supervenes, and may extend to the gum around any other tooth already erupted; the ulcers thus formed have a sloughy appearance. The breath is foetid and hot. In addition there is marked pyrexia, and at times disturbance of the chylopoetic viscera.

(3) The *exanthematous fevers*, which specially affect the mucous membrane of the mouth, may, if they occur during the process of dentition, give rise to sloughing of the gum over the erupting tooth, and, unless arrested, this may spread and cause severe ulceration of adjacent parts.

¹ Coleman, *Dental Surgery*, page 9.

Treatment.—The first of these local conditions is best treated by the administration of a brisk purge, which generally will relieve the local symptoms, and the gums can be scarified by giving the child a hard substance to bite at, such as a lump of sugar. Should the symptoms persist, it is best to remove the tension at once by free incisions. The second is best treated by the local application, and by the internal administration of chlorate of potash, care being taken that the bowels are freely relieved. The chlorate of potash can be rendered palatable by administering it mixed with sugar in equal parts. The symptoms generally yield to this treatment. The third condition is relieved by touching the ulcer with some escharotic, such as pure phenol.

In addition to the above troubles, most authorities are of opinion that the process of teething may give rise to reflex disturbances. While, no doubt, the process does in many cases initiate such troubles, it is probable that this liability has been much over-stated, as it is more than possible that many of the conditions which do occur at this period may arise from causes other than dentition; for it should be remembered that development of other special organs is taking place, and may give rise to constitutional disturbance, while some can be accounted for by errors of diet either on the part of the mother or infant. These disturbances may be grouped as follows:—

- (1) Affections of the cerebro-spinal system, *i.e.* restlessness, sleeplessness, convulsions, or paralysis.
- (2) Affections of the respiratory tract, *i.e.* cough, catarrh, laryngismus stridulus, or bronchitis.
- (3) Affections of the alimentary tract, *i.e.* loss of appetite, diarrhœa, or vomiting.
- (4) Affections of the skin, *i.e.* erythema, eczema, herpes, or impetigo.
- (5) Affections of the genito-urinary tract, *i.e.* increased or diminished secretion of urine, and in one instance a discharge from the penis, resembling a violent gonorrhœa, was recorded by Hunter.

The treatment of these conditions naturally falls within the

province of the medical practitioner, but we may refer to a few of them. The most important of those following under the first head is convulsions. An attack usually commences with slight twitchings of the hands (the thumbs being drawn into the palm), feet, and face, which may extend to the head, neck, or limbs. The patient becomes unconscious; sensation is absent, the retina insensible to light and the pupil either dilated or contracted; hearing is also affected, the pulse is small, frequent, and difficult to count, the patient is in a profuse perspiration, with hurried and difficult breathing, which may ultimately end in coma and death. Here again it is advisable to remember that many other causes can give rise to such convulsions, and before proceeding to make a free incision into the gums, it is wise to eliminate all other sources of irritation. One of the most common sources of convulsions in children is trouble in connection with the gastro-intestinal tract, and a fit may be brought on by indigestion or constipation. The former of these is best treated by bicarbonate of soda and bismuth, or belladonna, the latter by enemata of hot water at a temperature of 100° Fahr., and indeed this latter treatment will nearly always relieve convulsions in their earlier stages. Probably the benefit accruing from this method of treatment can be accounted for on the hypothesis that the sudden and unusual presence of the hot water causes the direction of the nervous activity that was acting on the cerebro-spinal system to pass from that to the gastro-intestinal system. It is a good plan, in all children with a tendency to convulsive seizures, to administer hypophosphites in one of its many forms, of which Fellowes' or Squire's are among the best. Morris J. Lewis, in the *Cyclopedia of the Diseases of Children*, edited by Dr. Keating, lays stress upon the fact that very commonly convulsions are merely a symptom of approaching death supervening upon other serious disturbances.

Having satisfied ourselves that no other cause is likely to be producing the trouble, we should proceed to lance the gums over the tooth which would in the ordinary course of events be next erupted; for although the tooth itself may not be the actual

originator of the trouble, the letting of blood will have a beneficial effect. In this connection should be mentioned the best methods of carrying out this operation. A curved bistoury should be used, and in order to prevent injury of surrounding parts, the knife with the exception of half an inch of the point should be wrapped round with a napkin or strip of lint. For lower teeth the infant's head should lie face upwards on the assistant's or nurse's left thigh, the child's hands crossed and held on its abdomen by the right hand of the assistant, the legs being held steady by his right arm, the head held and eyes covered by his left hand; for the upper teeth shift the head to the right thigh, the feet being towards the light, while for lower teeth the head should be towards the light.

The authors are of opinion that when it has been decided to use the knife, it should be used thoroughly, and the best method is to make two semilunar incisions meeting at their extremities, removing with a pair of tenaculum forceps the intervening portion of gum.

With regard to the second and third groups, it is probable that they can be accounted for on the grounds of reflex action from the connections and communications existing between the fifth pair of cranial nerves, the pneumogastric, and glosso-pharyngeal; and the relief which occurs after lancing in some of these cases is due to the relief of tension which is causing irritation at the periphery of the fifth pair of nerves, while the local trouble in the mouth can in a great measure account for the loss of appetite and nausea.

In connection with the fourth group it is an acknowledged fact that infants are exceedingly prone to these eruptions on the skin, and it is very doubtful whether they in any way originate from difficulties of dentition.

With regard to the fifth group, it is difficult to understand how any trouble of the teeth can produce urethritis, but that such a fact is recorded by so careful and painstaking an investigator as John Hunter is a fact that cannot be overlooked in dealing with this subject. A possibility of such a connection may be rendered

comprehensible when we remember the metastasis that takes place between the parotid gland and the testicle or ovary in the case of mumps.

The development and eruption of the teeth are seriously affected by several constitutional diatheses—syphilis, struma, and rachitis. Syphilis appears only to affect the first dentition so far as eruption is concerned, which is materially accelerated by it; struma acts in much the same way; while, on the other hand, rachitis considerably delays it. The lesions produced by these various diatheses manifest themselves in the permanent dentition, and will be referred to in treating of that subject.

In considering the question of eruption, it will be remembered that there are twenty deciduous teeth, which in a normal state are developed in the body of the jaw, and the earliest appearance of these is six months after birth, the process of eruption continuing until the beginning of the third year. From these facts it may be gathered that the normal food of the child for the first few months of its existence is that which nature provides in the parent, and it is of the utmost importance that during this period only that form of nutrition should be administered to the infant; but as in these days it is often impossible for the mother to suckle her own child, it is imperative that a wet nurse should be provided, as the due and proper development of the organism, including the teeth, cannot be properly maintained by any other means. The alimentary canal for some time after birth is not adapted for the digestion of starchy substances. From this fact it will be seen that artificial foods containing starchy matters should not be given, for fear of causing alimentary trouble, and so hindering nutrition. If for some important reason the child cannot be nursed at the breast, it should be fed for the first eight or nine months of its life upon humanised milk or cow-milk, water and sugar, while a little barley-water can be added with benefit should nausea or vomiting supervene. Parents cannot be too careful about the milk used for their children, as in addition to typhoid fever, diphtheria, scarlet fever, etc., tuberculosis may be transmitted by tuberculous cattle. All

biscuits and farinaceous food should be strictly forbidden. Having been weaned, the child should be fed upon good beef tea, a little gravy and vegetables, gradually adding underdone meat. We should here like to offer our protest against the use of whole-meal bread and coarse oatmeal, forms of food that have been recommended upon good authority because the husks of the corn which is included in this form of diet contain the phosphates so necessary for the due development of the bone, brain, and teeth; but, inasmuch as the phosphates so administered cannot be assimilated, the husks act only as a mechanical irritant to the intestinal tract.

In speaking of eruption of the teeth, we have given the dates in the normal condition; now we have to refer to some of the abnormalities. It has been incidentally mentioned that syphilis and struma accelerate eruption, and many cases are on record of children with these taints erupting teeth soon after or even before birth. The treatment in these cases in former times was the immediate removal of the tooth, and even now should they be rudimentary or mere shells the best treatment is to remove them; but, as an indiarubber guard has been invented to protect the nipple, provided of course the tooth or teeth be normal in character and position, it is better to adopt a conservative treatment and retain them.

Rachitis or rickets, as above mentioned, retards the eruption of the teeth; this affection is more commonly the result of bad hygiene and bad feeding than a constitutional taint. Many cases of rickets are produced by the fact that to keep children quiet they are given sweet biscuits to suck at all times of the day, so that the normal periods of feeding are interfered with, and the due nutrition hindered. In such cases it is of the utmost importance that these methods should be stopped, and children only fed at proper times. Perhaps the best form of treating cases in which rickets has developed is by the use of minced raw meat covered with sugar, and, in addition, cod liver oil and steel wine and glycerine in equal parts, three or four times a day (Dr. Cheadle).

The process of eruption.—Various theories have been suggested to account for the phenomenon of eruption. The first explains the process on the principle of pressure brought about by the gradual elongation of the tooth. The second by deposition of bone in the crypt gradually forcing the tooth upwards, which is really only a modification of the first theory. The third likens the process to that which takes place in the sharks and rays, in which, it may be remembered, the mucous membrane they are developed in and to which they are attached, gradually grows and brings each successional row of the teeth to the margin of the jaws, the older being gradually lost. Mr. Coleman advanced this theory in a paper contained in the *St. Bartholomew's Hospital Reports*, 1867, page 91, and it received the support of Prof. Owen, who pointed out that a similarity of idea had occurred to him, and was referred to in his *Odontography*, page 639.

Against the first of these theories some powerful arguments have been advanced. For instance, teeth with stunted roots are occasionally erupted; the distance the crown of a tooth travels in the process of eruption is often much greater than the addition of tissue which is added to its root during the same time; lastly, teeth with fully formed fangs may remain buried during the whole lifetime of the individual, or may only erupt late in life; but with regard to this last argument it must not be forgotten that the crown of the tooth may have become misplaced in its direction, and the addition to the root might simply force it further in its abnormal position. All we can say at present about eruption is that the tissues overlying the tooth are removed by absorption cells (giant cells), and that the stimulus leading to the presence of these cells is the presence of the erupting tooth which is impelled forward by a force, the origin of which cannot, with our present knowledge, be satisfactorily accounted for.

CHAPTER II.

ABNORMALITIES AND DISEASES OF THE TEMPORARY TEETH.

ABNORMALITIES OF THE TEMPORARY TEETH.

ABNORMALITIES of the temporary teeth may be classified as follows :—(a) abnormalities in size ; (b) abnormalities in number ; (c) abnormalities in position ; (d) abnormalities in structure.

(a) **Abnormalities in size.**—By abnormality in size is meant a variation from the normal, as, for instance, when one or more teeth are comparatively larger or smaller than the rest of the set. Two instances of this abnormality may be met with in the temporary dentition, in the upper canine and lower second molar. The interest attaching to these is to be found in the fact, that, should they persist, it is sometimes difficult to distinguish them from the permanent teeth, but if care be taken in the examination of the mouth and the history of former extractions ascertained, no error is likely to arise. A temporary canine can generally be distinguished from a permanent one by the abrupt termination of the enamel at its neck ; the tooth will be found to have undergone some attrition of the cutting edge ; it will appear smaller in proportion to the permanent teeth of the arch in which it is found ; and lastly, the enamel is generally translucent. A second lower temporary molar may be distinguished from a permanent one by the abrupt termination of the enamel at its neck ; by the

absence of the second bicuspid ; by the attrition of the surface ; by its being generally wedged in between the first bicuspid and the first permanent molar ; it is also usually on a lower level than either of the teeth between which it is wedged.

(b) **Abnormalities in number.**—By abnormalities in number is to be understood either any excess or deficiency in the number of teeth found in the temporary dentition.

Well authenticated cases of the complete absence of both temporary and permanent teeth have been recorded.¹ Absence of one or more temporary incisors, either upper or lower, is not so common as an excess in number. These supernumerary teeth simulate in shape those in the neighbourhood of which they are found, and for this reason have by some authors been classified as supplemental teeth. They are generally found in the incisor region. In a case which Mr. Ackery reported, and the history of which he followed (see fig. 3), the six temporary

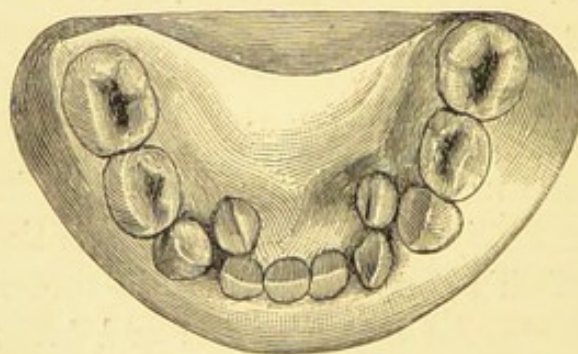


FIG. 3.

teeth in the incisor region were succeeded by six permanent ones.

(g) **Abnormalities in position.**—Abnormalities in position are of two varieties—those relating to mal-position of individual teeth, and those that have to do with the relative position of the maxilla to the mandible. The only form of irregularity of the first variety which has come under the authors' notice is a slight crowding which leads to overlapping and twisting of the incisor teeth (fig. 4). In the second variety there are three more or less

¹ *American System of Dental Surgery*, vol. iii. p. 405.

common conditions—(1) Protrusion of the lower jaw, (2) Edge to edge bite, (3) Lack of anterior occlusion (open bite).

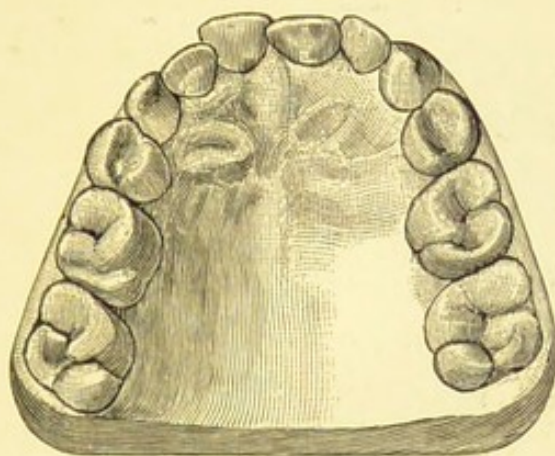


FIG. 4.

(1) **Protrusion of the lower jaw** is occasioned when one ramus is developed out of proportion to the other. Dr. Talbot, in his *Irregularities of the Teeth*, states the cause to be “an excessive length of the rami of the lower jaw”; by the context Dr. Talbot evidently means the ascending rami. This abnormality may be produced by arrest of development of the upper jaw, and is generally hereditary. In the former it is desirable to commence treatment as early as possible, and in a case reported by Dr. Kingsley the following method was adopted:—

A metal cap to fit the chin was made with hooked arms attached to it in a direction corresponding with the ascending rami. A skull cap was then made to fit the occipital region, to which two elastic bands with eyes were attached, the hooks proceeding from the chin cap were then hooked into these eyes. It will be seen by this means that direct pressure is brought “to bear upon the chin.” This contrivance must be worn day and night for a satisfactory result to be obtained, but it is to be feared there is a strong tendency in all these cases for the irregularity to return. An explanation of the changes taking place in the correction of this deformity has been given. It is said the pressure causes absorption of the posterior side of the condyles and the pushing of these into the glenoid cavities of the temporal bones, thus

practically forming a new articulation, a condition of things which is highly improbable. On the other hand, the pressure



FIG. 5. (Kingsley.)

may cause the ascending ramus to become more perpendicular, thus aiding nature in her natural processes ; but the authors would strongly advise that these cases should not be treated until after the eruption of the permanent teeth. In cases of arrest of development of the maxilla, treatment is to a great extent useless.

(2) **Edge to edge bite** is probably due to causes similar to those which produce the preceding abnormality. Treatment is usually not called for, but at any rate is best postponed till after the eruption of the permanent connection.

(3) **Lack of anterior occlusion, or open bite** may be caused in several ways—by thumb, finger, lip or tongue sucking, or may be due to want of development of the ascending ramus, and it

might, in some instances, be due to a partial arrest of development of the intermaxillary bone. In treating these cases the first step should consist in curing the child of any habit he may have acquired; for instance, in thumb or finger sucking the hand should be enclosed in a coarse flannel bag at night, while during the day the parents or attendants should be instructed to see that the habit is checked. In lip sucking, a thin flange of metal or vulcanite can be attached to the upper or lower incisor teeth to prevent the lip from getting behind the upper incisors. Tongue sucking is far more difficult to cure, and when it cannot be accomplished by moral persuasion, as a last resource an upper plate with one or two sharp metal points should be inserted.

Abnormalities in structure.—Additional cusps and variations in the number of the roots are more rarely found in the temporary than the permanent dentition. The second molar occasionally has an additional cusp, and Mr. Tomes¹ records a case of a strongly pronounced conical cusp arising from the posterior surface of a central incisor. A variation in the number of the roots is found in the molar region, the upper molar having four roots and the lower one three, while occasionally the canine may have its root bifid.

The so-called honeycombed condition is met with, though rarely. In the three specimens figured this condition is well shown (fig. 6). In the canine the enamel has been attacked in



FIG. 6.

the neighbourhood of the neck, the lesion being therefore produced by some cause acting after birth, while in one molar the enamel attacked is on the masticating surface, and was therefore probably due to some arrest of development *in utero*.

¹ *Dental Surgery*, 3rd Edition, p. 32.

Gemination is that condition in which two or more teeth are united together (figs. 7 and 8). It is rarely symmetrical. It is

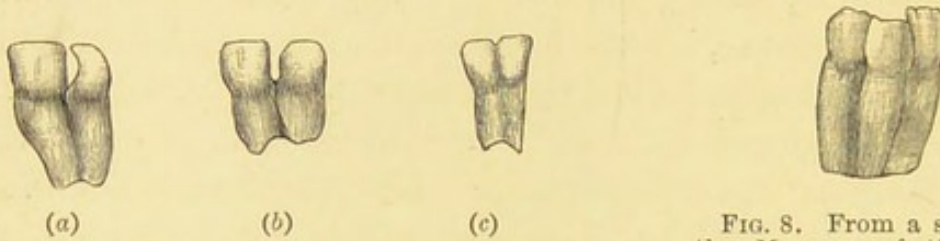


FIG. 7.

FIG. 8. From a specimen in the Museum of the Odontological Society.

commoner in the temporary than in the permanent teeth, is more often seen in the lower than in the upper jaw, the lateral incisor and canine being the teeth most frequently united, but gemination of the central and lateral incisor is also recorded.

Gemination is usually congenital, and is not due to pathological causes, as it sometimes is in the permanent set. Mr. William Hern has recorded a case where geminated teeth were followed by the absence of a permanent incisor in the same region, which points to the fact that only one germ was given off from the two teeth.

In some cases at the point of union a well marked division can be seen (fig. 7 *a* and *b*), while in others this is nearly obliterated (fig. 7 *c*). The union in these cases is by continuity of dentine with dentine, but in some instances there is a coalescence of the pulp chambers.

DISEASES OF THE TEMPORARY TEETH.

As a general rule it may be said that temporary teeth should be kept as long as possible, for by this means we best ensure the growth of the jaw and prevent many forms of irregularity that are met with in the permanent teeth. In some cases judicious extraction of some of the temporary teeth is to be recommended. Where crowding of the upper or lower incisor teeth is imminent, the canine teeth being firm, it is best to remove the first temporary molar. In cases where the crowding is very marked, it is an excellent treatment, at the time of extracting the first

temporary molar, to remove the unerupted first bicuspid. For this purpose a pair of long bladed forceps are required, the outer blade of which should be kept well outwards, and the operator must not be surprised in his first attempt to find that the forceps have to be pushed deeply into the tissues before the tooth can be grasped.

Some operators prefer to remove the temporary canine, giving as their reasons—which are good ones—that the overcrowding in the bicuspid region is prevented, and the permanent canine, which will ultimately erupt high up in the arch, can easily be treated.

The second temporary molar should not be extracted until the permanent successor is ready to be erupted. On this point too much stress cannot be laid, and even when alveolar abscess arises, it is better to open it from within the mouth than to remove the tooth. Too early extraction of this tooth permits the first permanent molar to move forward, and causes crowding of the bicuspid region, which leads either to irregularity of the canine or second bicuspid.

Caries in the temporary teeth in no respect differs from that found in the permanent dentition. The etiology and pathology of this, together with periostitis, alveolar abscess, and other diseases which are common to both dentitions, will be dealt with subsequently. The question of the treatment of caries and the operation of extraction of the temporary teeth have special points of interest which will now be considered.

Treatment of caries.—The teeth most commonly attacked are the molars on their approximal surfaces, and children should be kept under careful dental supervision in order that the early signs may be recognised and the caries treated. The best method of dealing with them in the early stages is to remove the carious tissues and to fill cavities with a copper amalgam. In more advanced stages, the pulp not being exposed, the contiguous cavities may be plugged with one filling of permanent gutta percha or amalgam; the rationale for this treatment being that it is impossible in such young patients to properly shape the

cavities—so many of them after excavation being found to be saucer-shaped. As a rule, it is inadvisable to employ either engine or rubber dam, for it is very important that children should not be terrified; with children however of a brave temperament it is of course possible to do more thorough work.

In cases where the pulp is found to be exposed, and the patient is of such an age that the roots of the offending teeth are probably much absorbed, it is best to temporise. For this purpose the parents may be instructed to keep the cavities plugged with some dressing, and the following is a useful form.

R	Ol. caryophylli,	ʒij.
	Mastich,	ʒj.
M.	To be applied on cotton wool to cavities.	

The oil of cloves acts as a sedative to the nerve, the mastich forming a temporary plug.

In cases occurring in patients of an earlier age, before absorption of the roots has commenced, it is better to apply some devitalising material. Arsenious acid should be employed, a small quantity being used, and the dressing removed within twenty-four hours. The pulp should be extracted as carefully as possible, the cavity rendered aseptic, and filled with gutta percha. It is also recommended by some, in the place of filling the pulp cavity, to cap it and perform rhizodontrophy (drilling a small hole from the outside of the tooth into the pulp cavity).

When the pulp is found to be dead and disorganised, its debris, which is usually of a foetid character, must be removed, a hooked Donaldson bristle being useful for this purpose. Care must be taken to avoid pushing any of the septic material through the apex of the root. There is a great danger of this from the fact that absorption of the fangs may have already commenced. The pulp chamber should be thoroughly syringed out and rendered aseptic by injecting a solution of perchloride of mercury 1 in 1000 into the canals by means of a hypodermic or other syringe. The canals should then be dried and tested to see if they are aseptic. This may be done by passing a small piece of cotton

wool on a bristle, and if free from odour when removed the cavity may be filled. There are cavities where it is difficult to thoroughly carry out this aseptic treatment, on account of the position, and the fact that it is undesirable to inflict much pain upon so young a patient; and in such cases it is best to remove as far as is possible the contents of the pulp cavity, leaving the canals untreated; rhizodontrophy should be performed, the pulp chamber capped, and the cavity filled.

Occasionally patients are seen with caries of a superficial character, giving rise to broad saucer-shaped cavities, the exposed dentine of which is at times very sensitive. Absolute alcohol frequently applied to these will tend to produce hardening of the exposed dentine. It is necessary before applying the alcohol to thoroughly dry the teeth, and the saliva should be kept away for a minute or two after the application. An alkali can with advantage be added to the spirit—the saliva in these cases having usually an acid reaction. Nitrate of silver very readily cures this sensitiveness; but, inasmuch as it blackens the surface to which it is applied, its use is restricted to the back teeth. It is necessary to use caution in its application, and on no account should it be held between the blades of conveying forceps, because it may slip from them and pass either into the larynx (as is known to have happened in one case) or into the stomach. In the first case inversion might be tried with the hope of gravity assisting, but skilled surgical aid should immediately be sought; in the second a plentiful supply of common salt should be given, as this will cause a chemical reaction leading to the formation of the insoluble and inert chloride of silver. To apply nitrate of silver a small piece should be melted on to the end of a broken excavator; it will form a small bead on the end of the instrument, and can then be applied to any place with accuracy.

Many difficult cases, which are not suitable for filling, should be dealt with by so shaping the teeth with enamel chisels that no food can be retained between them, the wedging of the débris of food between carious teeth being a constant source of irritation and pain.

THE OPERATION OF EXTRACTING TEMPORARY TEETH.

As a general rule it may be laid down as an axiom, that temporary teeth should be allowed to remain *in situ* as long as possible, the purely normal condition being that in which teeth are shed by natural processes.

The interference of the dental surgeon is called for under the following circumstances :—

(a) A temporary tooth remaining persistent and preventing the eruption of its successor, also when the second tooth has erupted in an abnormal position.

(b) Cases of acute alveolar abscess, accompanied by febrile disturbance and with great swelling of the soft tissues, caused by the pus having perforated the bone and invaded the structures of the cheek, which, unrelieved, would probably open externally.

(c) Cases of necrosis of the teeth, where the fangs protrude through the alveolar plate and gum, giving rise to ulceration on the contiguous surface of the cheek, which is followed by the formation of cicatrices (figs. 9 and 10). This condition, which in our experience is only found in the temporary dentition, is probably due, in the first instance, to an alveolar abscess, which has caused necrosis of the root, partial or entire, and also absorption of the socket in which the fang is embedded ; the erupting permanent tooth may also assist in helping to produce the above condition.

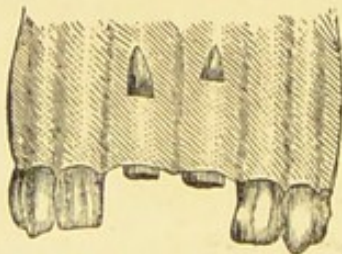


FIG. 9. (Coleman.)

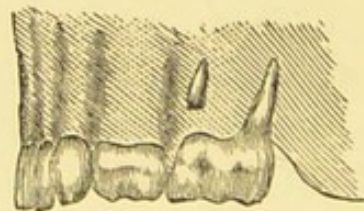


FIG. 10. (Coleman.)

It is desirable to impress upon the operator the inadvisability of deceiving the patient by such methods as concealing forceps up the sleeve or taking the child unawares, and to be as rapid as

possible in the operation, the patient nearly always being very nervous.

For the lower teeth, a small pair of incisor forceps, and small hawkbill molar and stumps forceps, with a small elevator, are all that is necessary; while for the upper, a small pair of straight and two pairs of molar forceps, one for each side, with a fine pair of stump forceps for the removal of fragments, will furnish the complement for the temporary teeth.

In removing molars with frail walls it should be remembered that the germs of the bicuspid are in close proximity to the roots, and if in the operation the tooth should be fractured, it is better to leave the fang or fangs in until they can be removed with ease at a later period. Too persistent efforts are inadvisable, as there is a danger of injuring the developing tooth, or accidentally removing it. The anatomical formation of the upper teeth renders this accident more probable in the molar region, and the developing tooth may be so embraced by the curved fangs of its predecessor that its removal, together with the deciduous tooth, is unavoidable. Small fragments are best extracted with fine forceps, or, if loose, with the elevator; but in those cases where the apex of the fang has protruded through the outer wall of the alveolus and gum, an elevator placed between the fang and the gum, with the thumb of the hand which grasps the instrument placed on a contiguous tooth and pressure applied in a direction towards the thumb, will readily effect the removal. It is possible that the fang may become so thin that the end will fracture. In such a case the removal will be effected by applying pressure to the fractured end of the fang, and removing it with forceps.

CHAPTER III.

SECOND DENTITION.

NORMAL DENTITION.—When complete the permanent set numbers thirty-two teeth. In the half of the maxilla and mandible respectively will be found a central incisor, a lateral incisor, a canine, a first and second bicuspid, and three molars, the first five teeth having replaced temporary teeth, the molars having had no predecessors.

The processes by which the fangs of the temporary teeth are absorbed have been dealt with by several authors, who have advanced the following theories explanatory of this phenomenon.

(1) That it is caused by the pressure of the cusp of the permanent tooth on the root of its deciduous predecessor.

(2) That it is due to the presence of an absorbent organ, consisting of a mass of large multi-nucleated cells.

If a temporary tooth, which has undergone absorption, be examined, the root will appear excavated in a cup-shaped manner, the loss of tissue being at or near the apex, and in fortunate specimens a soft vascular substance, the so-called absorbent organ, will be seen covering the excavated portion. A section of such a tooth examined microscopically will show, at the part attacked by absorption, well-marked Howship's lacunae; and if the section has been prepared by a method in which hard and soft tissues can be cut *in situ*, it will be seen that the soft vascular part is composed of a mass of cells, those nearest to the dentine being

multi-nucleated, and fitting into the cup-shaped excavation in the dentine. Fig. 13 is a drawing of the absorbent cells *in situ*. It will thus be seen that the so-called absorbent organ is only

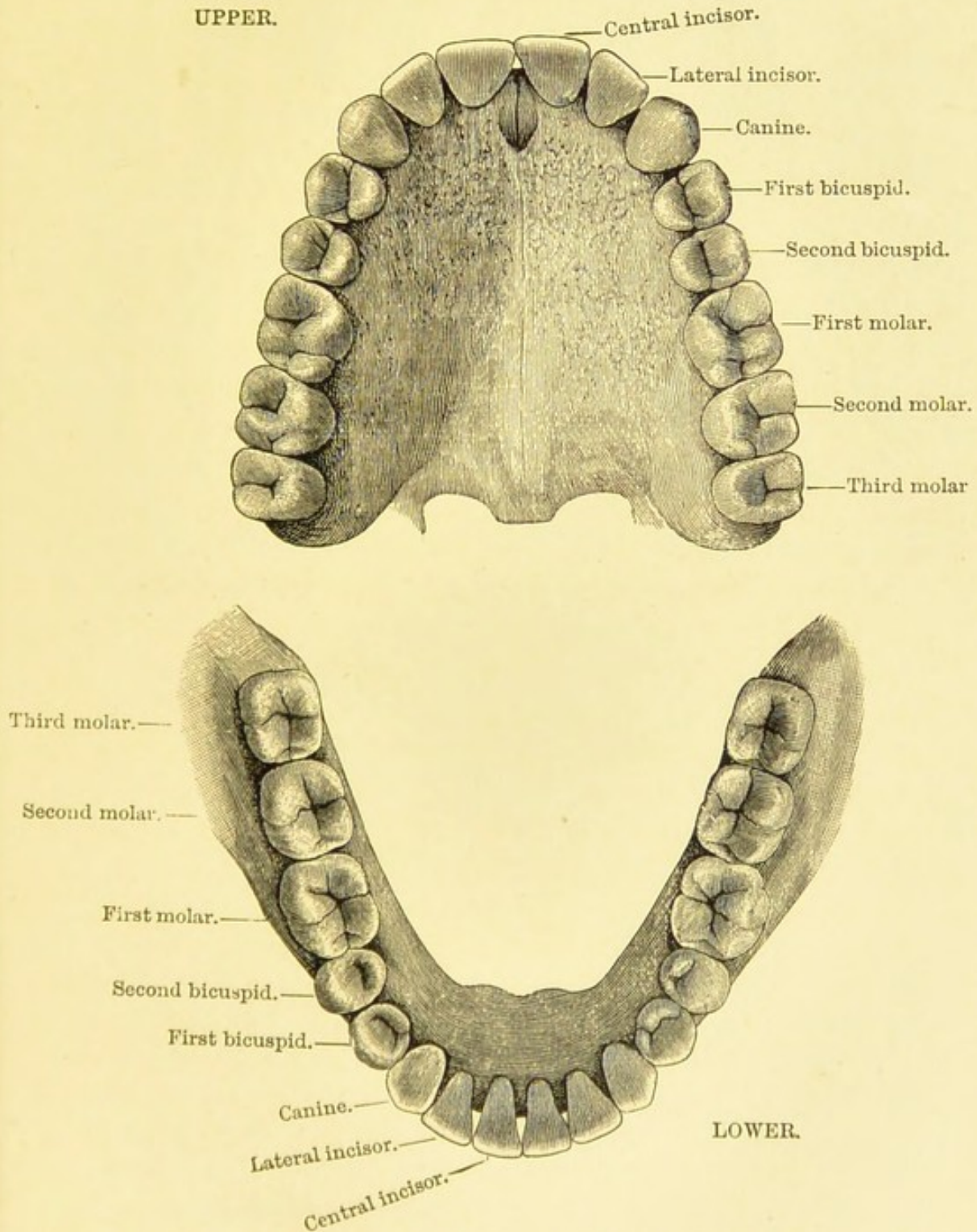


FIG. 11. Represents a fully developed set of permanent teeth.

a mass of cells, some of which act as osteoclasts. In absorption of the permanent teeth, a typical example is the pressure of the

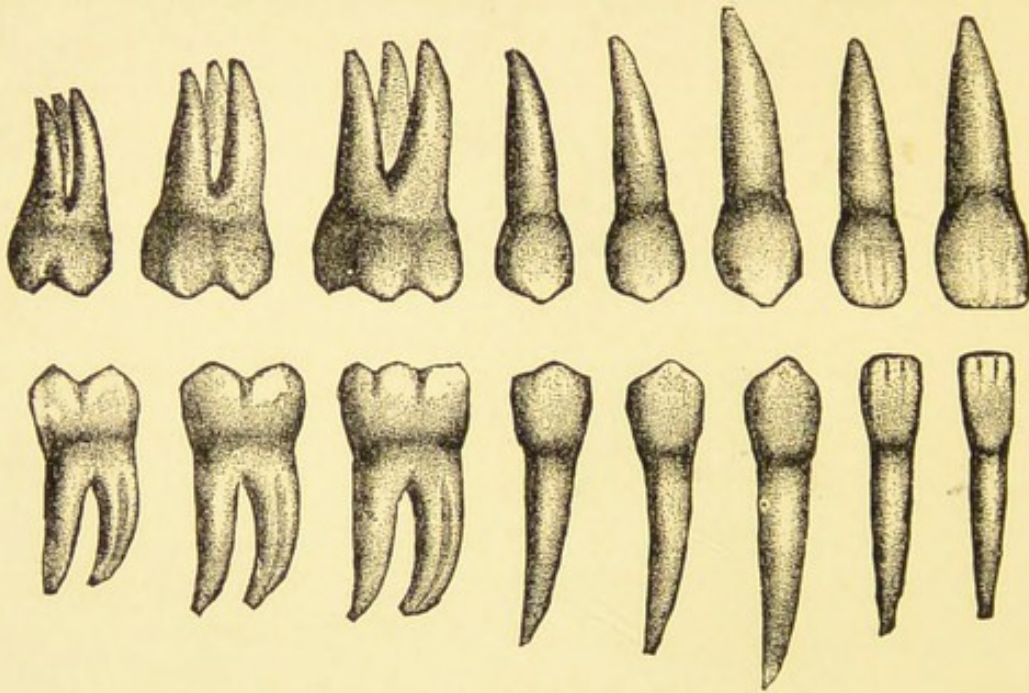


FIG. 12. Represents the permanent teeth separately.

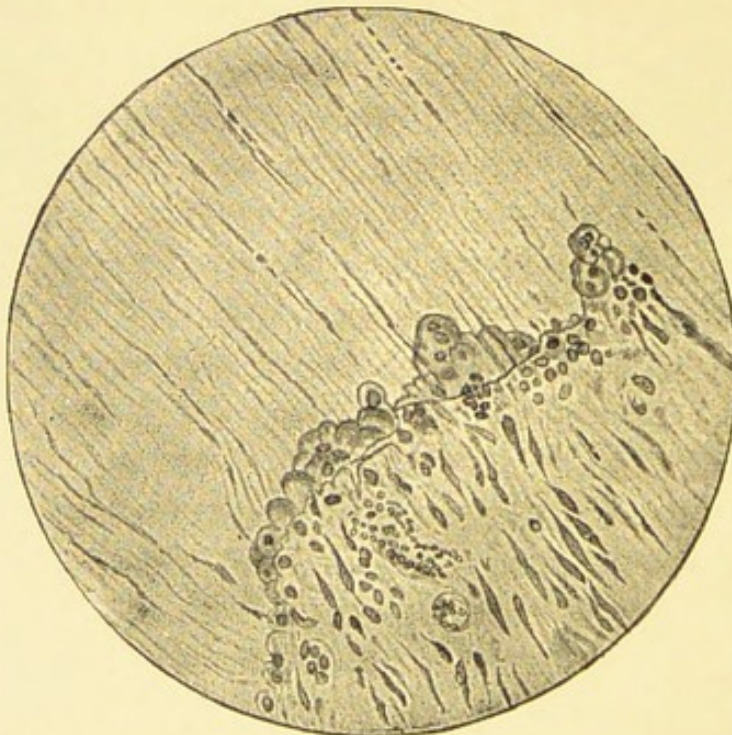


FIG. 13.¹

¹ For this drawing we are indebted to Mr. J. Howard Mummery.

lower third molar upon the posterior root of the second lower molar, a section through the absorbed portion will show exactly the same condition as seen in an absorbed temporary tooth ; and also in specimens of absorption of the roots of the permanent teeth, the result of chronic inflammation, Howship's lacunæ can be seen filled with the characteristic giant cells. The disappearance of the tooth tissue of the temporary tooth seems undoubtedly to depend upon the presence of these multi-nucleated or osteoclastic cells. How they perform their work is doubtful. Some have advanced the theory that they send out amoebiform process, others that they secrete an acid and thus dissolve the tooth substance, but it is more probable that they possess a phagocytic action. What determines the presence of the so-called absorbing organ is as yet unknown. Whether it is due to the presence of and pressure from the permanent tooth, or to some other agency, is a problem which still awaits solution.

Dates of eruption.—The following table gives the approximate dates of the eruption of the permanent teeth :—

First permanent molar, - - - - -	6 years.
Lower central incisors, - - - - -	7 ,,
Upper central incisors, - - - - -	8 ,,
Upper and lower lateral incisors, - - - - -	9 ,,
First bicuspid, - - - - -	10 ,,
Second bicuspid, - - - - -	11 ,,
Canines, - - - - -	12 ,,
Second permanent molar, - - - - -	12 ,,
Third permanent molar, - - - - -	17 to 24 ,,

The first permanent molar is erupted behind the second temporary molar, the patient being usually unconscious of its appearance, and it is often mistaken by the parents for a temporary tooth.

Normal eruption is rarely accompanied by local or constitutional disturbances. Immediately on the shedding of the temporary tooth, the permanent successor makes its appearance, but

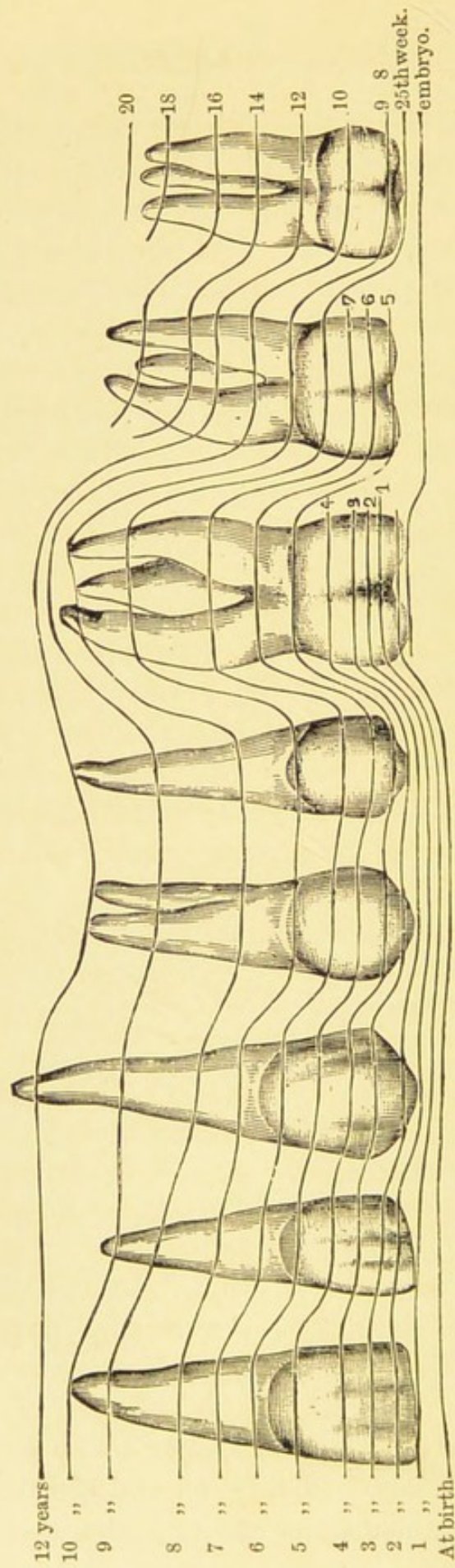


FIG. 14. From *The American System of Dental Surgery*.

its eruption is slower than that met with in the first dentition ; this may be accounted for by the longer fangs and more perfect sockets that have to be formed.

The calcification of the teeth at different ages is shown in the accompanying diagram (fig. 14).

Abnormal dentition.—Constitutional diatheses affect the eruption of the permanent teeth in much the same way as they do those of the temporary set. As an example, it is found that strumous and syphilitic children erupt their teeth early, while in those affected with rachitis the process is delayed. In children of a neurotic temperament, especially female, the eruption of the teeth is considerably accelerated ; further, any deviation from the normal standard of health may affect the dates of eruption. This irregularity in the date of appearance is well marked in the canines, which will be found erupting frequently before the bicuspid, the lower ones as early as nine years.

The third molar is found to erupt earlier than normal under the following conditions:—(a) after extraction of the second molar, the third molar has been known to appear at fifteen years or even earlier ; (b) after extraction of the first permanent molar, especially when the operation has been performed before the eruption of the second molar, the second permanent molar is thus allowed to move forward, and permits the early eruption of the third molar.

Eruption of individual teeth is at times retarded.—Thus in the maxilla, the eruption of the canine often takes place as late as between the age of twenty and twenty-five, while Mr. Salter records a case where the point of the canine first appeared through the gum at the age of seventy. The bicuspid are at times retarded, and we have under notice a patient in whom the second right upper bicuspid did not appear until the age of thirty-five. The third permanent molar is frequently retarded, and may erupt at any time up to the age of seventy. In the mandible frequent instances are seen in the case of the first and second bicuspid ; the appearance of these teeth may be delayed for two or three years, and is more marked in the case of the second one. The

third lower molar, like the upper one, may erupt at almost any age after puberty.

The causes which may give rise to these conditions are various, and perhaps one of the commonest is mechanical obstruction, due to crowding. This is well seen in the cases of the arrested eruption of the third molars and upper canines. Geminated temporary teeth may act as factors, and in one case the lower central incisor was prevented from erupting because absorption had taken place only at that part of the root corresponding to the temporary central incisor, leaving that portion of the root corresponding to the lateral incisor firmly embedded and unabsorbed. A temporary tooth, especially the second molar, may become wedged between its approximal teeth, these latter having slightly inclined towards each other. In those teeth that are erupted towards middle life after a period of considerable rest the growth is extremely slow, spreading over years, and in the case referred to above, five years have elapsed since its appearance, and even now it barely touches its antagonist in the mandible.

The local disturbances accompanying eruption of the permanent teeth are mainly confined to the third molars, especially the lower ones. Before the cusps are erupted local inflammation may attack the superincumbent tissues, and the signs of inflammation, pain, heat, swelling, and redness will be present. This condition is best treated by free incisions, or, what is perhaps better, by removing a portion of the overlying gum.

When a molar tooth erupts, the anterior cusps appear first, and the small portion of gum which lies over the posterior part of the tooth occasionally ulcerates, from constant pressure of the antagonising tooth. The ulceration may become extremely painful and the inflammation spread to adjacent tissues. The patient complains of pain in the region of the fauces; but perhaps the most tender point is where the mucous membrane of the gum becomes continuous with that of the cheek. This is best relieved by free incisions, taking care that the knife shall divide all the tissues overlying the buccal surface of the tooth. Should this not bring relief it is advisable to remove the process of gum that

is covering the tooth, which can be accomplished either with the knife and forceps or with specially designed instruments, such as those introduced by Mr. Robert Woodhouse. In addition, fomentation of the mouth inside should be advised, and perhaps hot water at a temperature just bearable is as comforting an application as any, although decoction of poppy heads is often to be recommended, the opium contained in the poppies acting as a local anodyne. When the ulceration is severe, mouth-washes of chlorate of potash, hazeline, or kalendula should be prescribed. Suppuration may supervene; and if the offending tooth be not removed trismus may occur. This is said to be produced in the majority of cases by spasm of the masseter muscle, due to reflex irritation, but more probably it is caused by spread of the inflammation to adjacent tissues. The insertion of the temporal and internal pterygoid muscles and the intervening cellular tissue may, by a process of continuity of inflammation, become affected, and thus produce closure of the jaws. This explanation seems more in harmony with the clinical aspect of the majority of cases generally met with; for, in nearly all, the patient is able to effect slight movement in the articulation, which would not be the case if the trismus was due to tonic spasm of the masseter muscle. Again, the mobility of the articulation increases as the inflammatory symptoms subside. Although the above appears to be a more correct explanation, in rare instances it may be due to clonic spasm of the muscles of mastication; but there is no reason why the spasm should affect the masseter more than the temporal or the pterygoid muscles, the nerve to all being derived from the same common trunk. The treatment of the above condition is to remove the erupting tooth. This is carried out as follows:—The patient should be anæsthetised, and the anæsthesia being prolonged if necessary by ether, although it is seldom necessary to push this to the length required for surgical operations, the mouth should be opened by a Mason's mouth-gag or an ordinary screw-gag, and the tooth removed with an elevator.

Third lower molars when impacted may give rise to severe

odontalgia in the second molar, the pressure from the erupting tooth causing absorption of the posterior surface of the second molar, leading to exposure of its pulp. The absorption in these cases is not due to the pressure of the crown of the third molar against the cementum or enamel of the second, but to multi-nucleated cells which are developed at the point of contact, and which perform the function of osteoclasts in removing the obstructing tissues. In these cases the second molar should be removed.

General disturbances accompanying eruption of the permanent teeth.—The most common is severe neuralgia, which may be due to pressure upon the main trunk of the inferior dental nerve. The pain being situated in the regions of the ear, face, and neck, may produce reflex odontalgia in any tooth or teeth on that side of the mouth. Hemicrania at times accompanies the eruption of the third molars, while cases of otalgia, epilepsy, and paralysis have been traced to this cause. Chorea has been stated to have been caused by reflex action, due to difficult eruption, but Dr. Sachs, in Keating's *Cyclopedia of Diseases of Children*, referring to reflex chorea, says, "I feel warranted in saying that there are very few cases of true reflex chorea, and the only cases I have seen which were of indubitable reflex origin were due to intestinal parasites." A still more rare condition is suppuration extending into the deep cervical fascia (*Angina Ludovici*), the direct result of suppuration about an irregularly erupted tooth. This condition from the anatomical relations of the cervical fascia may be of great gravity.

CHAPTER IV.

ABNORMALITIES OF THE PERMANENT TEETH.

ABNORMALITIES of the permanent teeth can be divided into those of (1) Size; (2) Number; (3) Position; (4) Structure.

(1) ABNORMALITIES IN SIZE.

There is no standard by which we can compare the relative sizes of teeth. It is possible to have the whole series composed of teeth of an abnormally large or small character, and examples are shown in the following figures (figs. 15 and 16). The upper

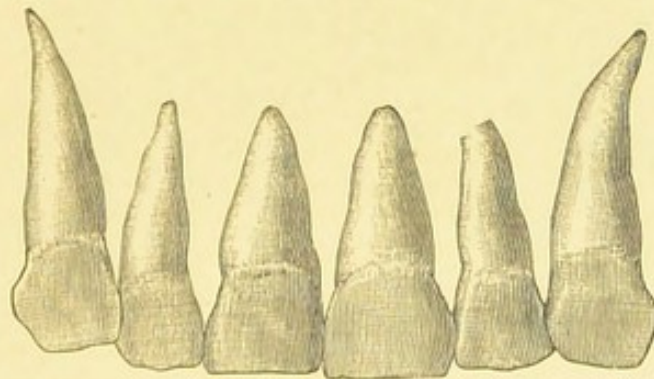


FIG. 15. From a specimen in the Museum of the Odontological Society.

central teeth are most frequently developed to an abnormally large size (fig. 17), but it should be differentiated from a central that has become geminated with a supernumerary lateral incisor. The second lower bicuspid is also frequently abnormally large, approaching somewhat in character to the molar. The second

lower molar is also occasionally affected in the same way. The lateral incisors in the upper, on the other hand, are often diminutive and modified in their shape, and in extreme cases are

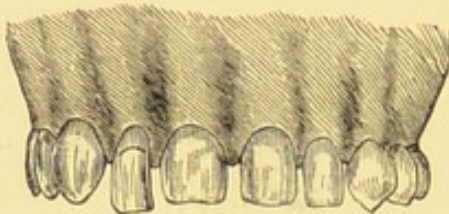


FIG. 16. (Coleman.)

little more than simple cones; occasionally, however, they may be abnormally large, as is seen in fig. 18. The upper third molar, like the lateral, is often dwarfed and modified in its shape.

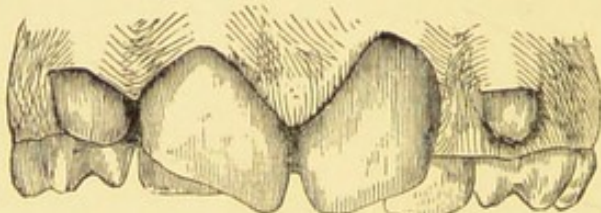


FIG. 17. (Coleman.)

(2) ABNORMALITIES IN NUMBER.

Variations from the normal number of teeth may be classified—

(a) Excess in number; (b) Deficiency in number.

(a) *Excess in number.*—Any tooth in addition to the normal number is known as a supernumerary tooth. They may be divided into two distinct groups—first, those resembling normal

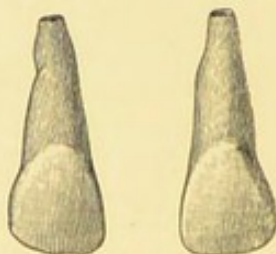


FIG. 18.

teeth in shape and character (called by some authors supplemental); second, those abnormal in form.

In the first class, the tooth usually resembles a lateral incisor, less frequently a bicuspid, rarely a molar, and, in very exceptional



FIG. 19. A small upper third molar.

cases, a canine. These teeth as a rule are found in the neighbourhood of the tooth they simulate. More commonly they occur in the upper lateral incisor region, but an extra incisor in the lower jaw is by no means rare. In the upper incisor region they are generally either larger or smaller than those in the normal position; the condition is often symmetrical. In the bicuspid region two additional teeth are occasionally met with,

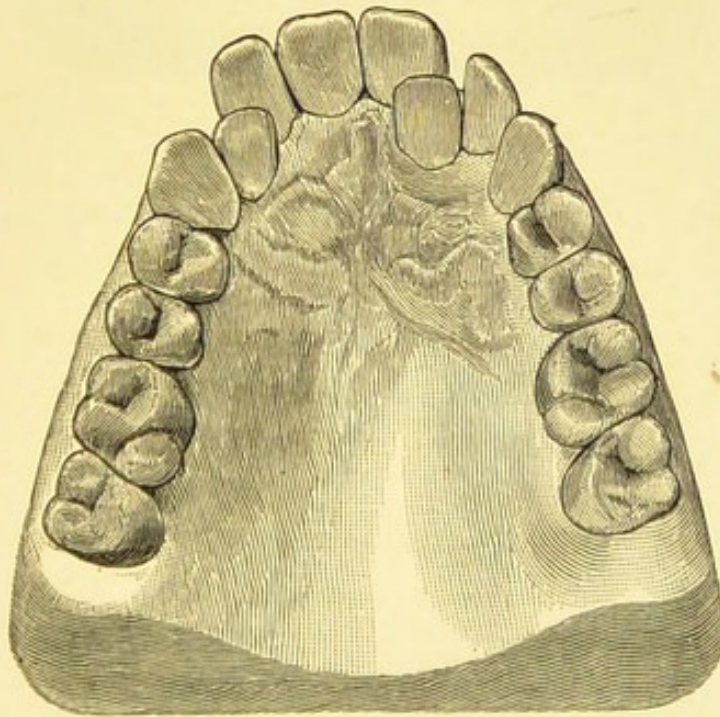


FIG. 20. Showing two supernumerary laterals.

and in a remarkable case which occurred in the practice of Mr. C. Handley, there were no less than six bicuspid teeth on the one side, and two other supernumerary teeth in addition (fig. 21).

In the molar region the additional tooth is usually to be found in the situation of the third molar, erupted either internally or

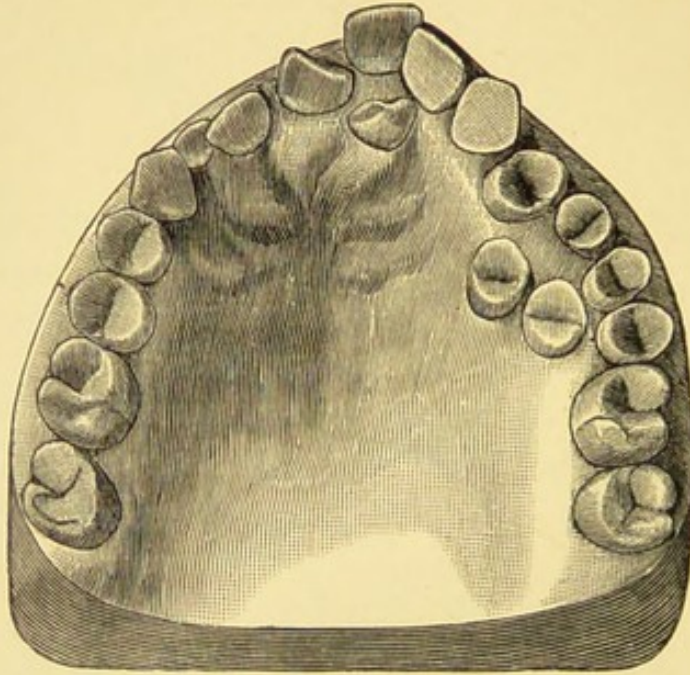


FIG. 21.

externally to the arch. Supernumerary teeth in the lower bicuspid and molar regions are also met with, but more rarely

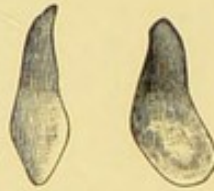


FIG. 22. Supernumerary teeth.

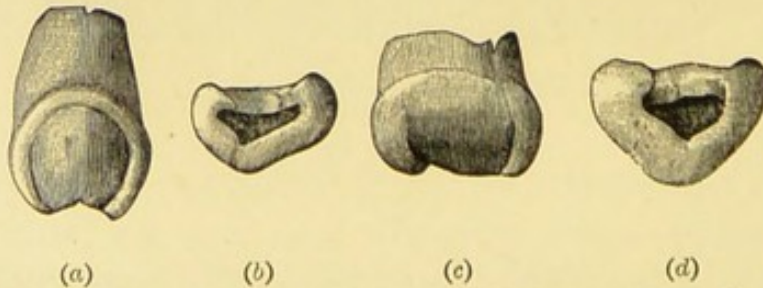


FIG. 23. Two supernumerary teeth of the tuberculated variety from the same mouth. (b) and (d) show the appearance of the crown surface of (a) and (c) respectively.

than in the upper. It may be noticed that these additional teeth are usually found in those regions where teeth have been suppressed from the typical mammalian dentition.

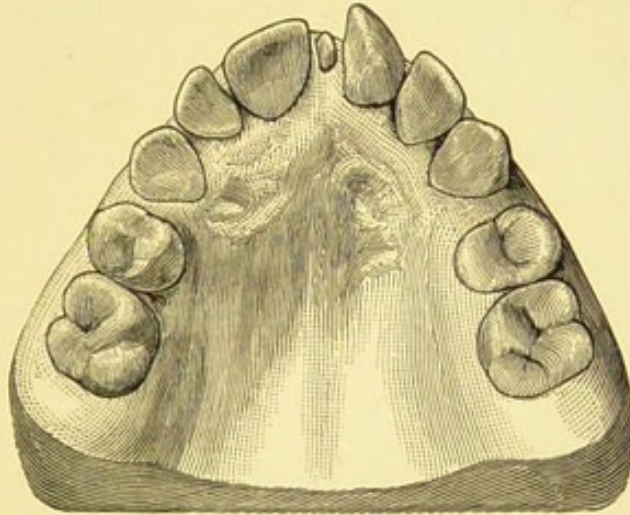


FIG. 24. Conical supernumerary tooth between the two central incisors.

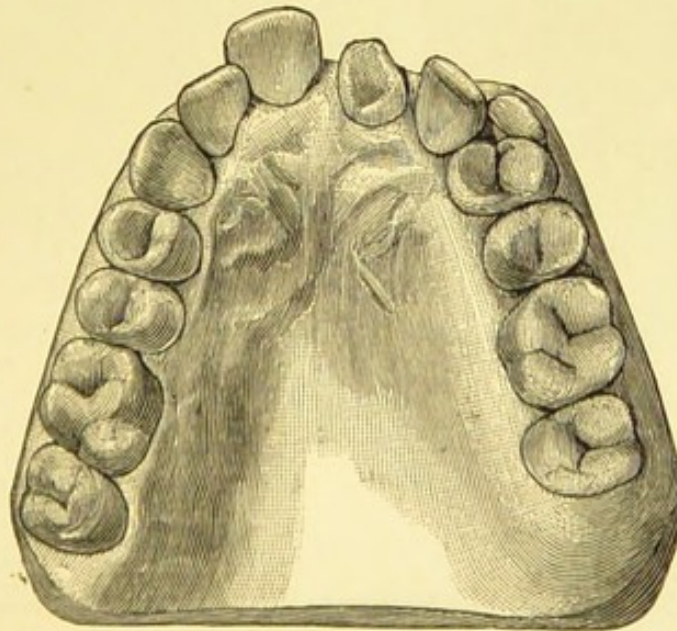


FIG. 25. Tuberculated supernumerary tooth replacing central incisor.

In the second class, great variety of shapes are met with, but the two following are the most common type—namely, the conical

and tuberculated. The number of these teeth also varies, and cases are recorded where five or even six have erupted. The conical ones are met with in the median line, between the central incisors, and may be present either in front or behind them. They are also found in the molar region, and at times appear as accessory cusps, being geminated with those teeth. The tuberculated varieties usually appear on either side of the median line immediately posterior to the upper central incisors, which may be displaced. They are sometimes symmetrical. In addition to the above situations, supernumerary teeth may occur in any part of the mouth. They are found more often in the upper than the lower jaw, and, when occurring in the latter, are met with in the molar region.

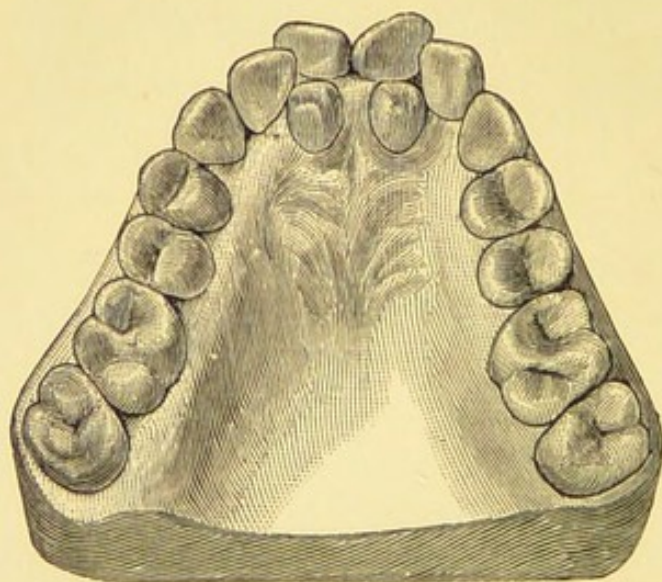


FIG. 26. Two supernumerary teeth immediately posterior to the central incisors.

It is difficult to account for the origin of these teeth, but an ingenious suggestion has been made by Mr. Bland Sutton, who has pointed out that masses of epithelium, called epithelial pearls, are found in those situations where these teeth usually occur, and it is probable that the same tissues that develop these epithelial pearls also give origin to the teeth.

Treatment.—Supernumerary teeth should be removed as soon as

they make their appearance, except in those cases in which they are geminated with other teeth, or are in the regular line of the arch and cause no crowding.

(b) *Deficiency in number.*—Cases are on record of congenital total absence of teeth, but are extremely rare. Patients are

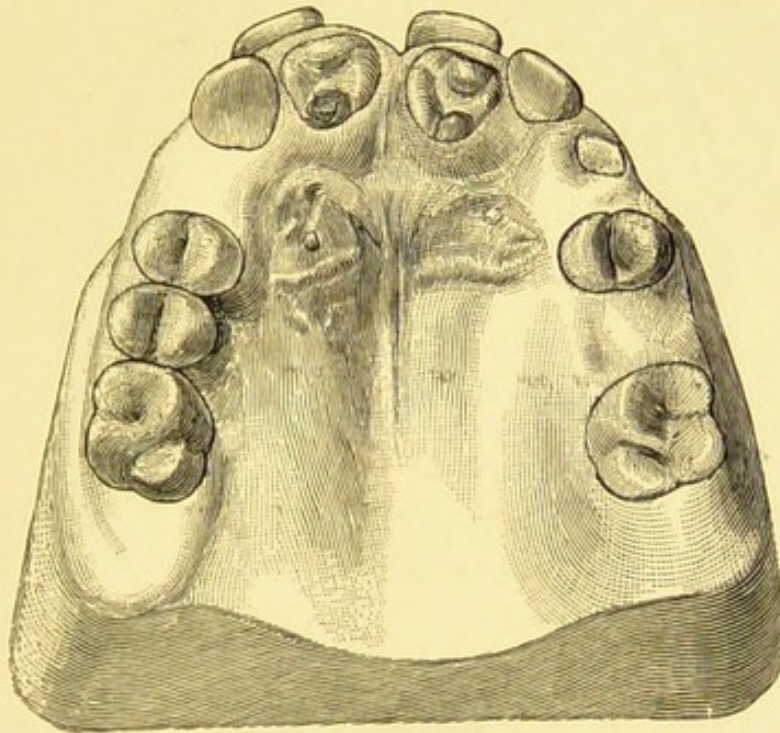


FIG. 27. Two molariform supernumeraries immediately posterior to the central incisors. From the museum of the Students' Society of the Dental Hospital of London.

frequently seen in whom a large number of teeth are missing, but the most common condition is that in which only one or



FIG. 28. Supernumerary tooth from region of the first upper molar. The tooth erupted in an inverted position.

two teeth are absent. In all cases of deficiency it should not be forgotten that teeth are often retarded in their eruption, and

care should be taken to differentiate this condition from the one under consideration.

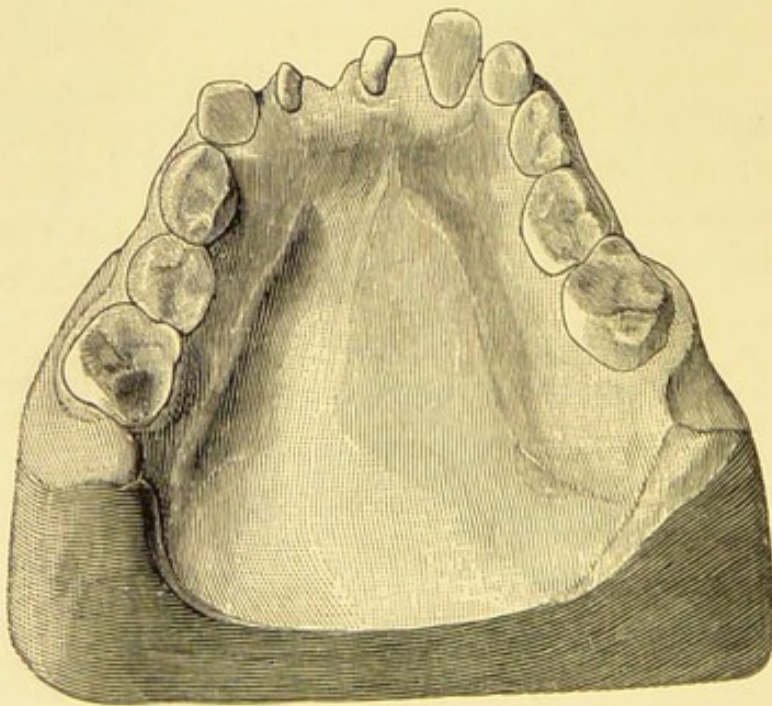
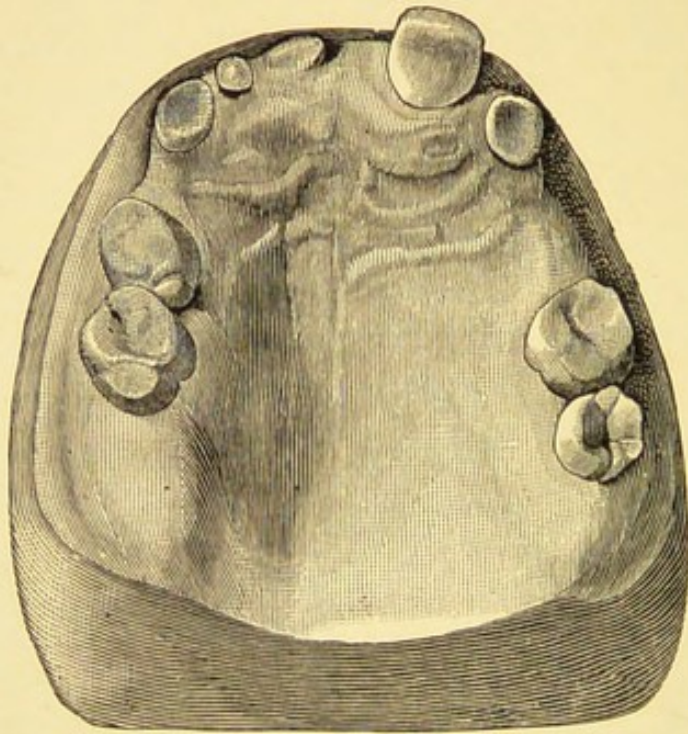


FIG. 29. Models showing deficiency in number of permanent teeth. The patient was a man, *æt.* 35.

When a large number of permanent teeth are absent it is usually found that a large proportion of the temporary teeth are persistent. Those permanent teeth which are present are usually a molar on either side, upper and lower, and one or two badly formed teeth in the incisor regions, but in a case reported by Mr. Ackery¹ there was a departure from this rule, the molars being absent, while a bicuspid on either side in the maxilla and mandible were present. In other cases of deficiency the bicuspid, or more rarely the molar series, may be absent; while of individual teeth the upper lateral incisor is most frequently absent; next in order, the second lower bicuspid, and then the third molar.

Absence of teeth from the series is not easily explained. Occasionally it is hereditary, while rachitis, and probably in some cases hereditary syphilis, may give rise to this condition; and in cases where one of the exanthemata has been contracted at a very early age the germs of the permanent teeth may have been arrested in their development. Other cases can be accounted for by accidental injury or removal of the germs of the permanent tooth in extracting the temporary predecessor. With regard to the absence of the third molar, the first permanent molar is sometimes removed at an early age, allowing the second one to erupt adjacent to the second bicuspid, and in such cases the third molar may be mistaken for the second. This mistake will not occur in the lower if it be remembered that the second molar has four cusps and the third one five. Where a large number of teeth are absent it is as well to prepare the mouth for artificial teeth by removing all temporary teeth, except those which are firmly implanted and can be made use of for retention of the denture.

(3) ABNORMALITIES IN POSITION.

This section of abnormalities brings us to perhaps one of the most difficult subjects that comes under the care of the dental surgeon. The vagaries of nature are so frequent, and the

¹ *Trans. Odontological Society*, 1891.

accidental causes that may give rise to various forms of irregularities so numerous, that it is impossible in a manual of dental surgery, where only a few pages can be devoted to the subject, to treat exhaustively of all the manifestations and varieties which occur. It is proposed, therefore, to deal rather with those that are more commonly met with in practice, and to consider them on general principles.

The causes giving rise to abnormalities in position may be divided into general and local.

General Causes.—*Heredity* has much to answer for in the causation of these irregularities, and it is often found that the irregularities have been foreshadowed in one or both parents. An example of this was well seen in a family under the notice of one of the authors, in which five out of a family of seven had the right central incisors slightly overlapping the left one. Another example is to be found in cases where the jaws and teeth of one parent are well developed, while in the other both teeth and jaws are small. The offspring of such parents may inherit the jaw of the one parent and the teeth of the other, and crowding be thus produced.

This hereditary transmission causing irregularity is well seen in countries where intermarriage of different peoples and types is frequent. It is well known that each community has types and features peculiar to itself, and as long as marriage takes place between members of the same community, so long the type remains constant; but directly marriage with members of other communities takes place irregularities result.

Neurotic tendencies are said by Kingsley to interfere with the nutrition of the jaws through derangement of the fifth pair of nerves, brought about by too much mental and not enough physical exercise during the developmental period. It is more probable that the increased strain upon the mental functions during childhood, combined with amusements of an exciting and too advanced a character, causes a larger supply of phosphates to be required for brain nutrition, and so robs the teeth of the salts which, in the more simple mode of life, would have been

used for forming those organs—in other words, the brain is developed at the expense of the teeth.

Crowding may be produced, in addition to those causes already referred to, by any disease which may arrest the development of the jaws. Such is probably the case in the *exanthemata*, *struma*, or any severe illness that may occur during the period of growth and development. The permanent teeth are formed at a comparatively early period, and during the developmental stage are found in a crowded condition in the jaw bones; to assume their normal position in the arch, it is necessary that the jaw shall develop in such a way as to allow room for them, and it is evident, therefore, that anything which arrests this development of the bone at a period subsequent to the formation

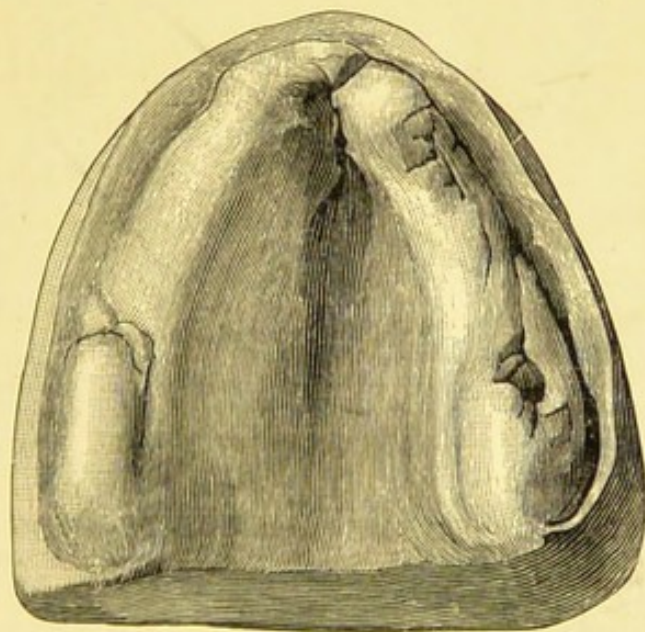


FIG. 30. Showing arrest in development of the upper jaw in a man of heavy build, and over six feet in height.

of the teeth must cause crowding of them. Arrest of development in these cases may confine itself to a small portion of the jaws, as the following figure will show. Excessive growth is also found, and may be the result of such constitutional causes as *rickets* or *hereditary syphilis* (this last being mentioned by Talbot). Local injury or continued irritation may produce a

like result by causing a determination of blood to the part. In the maxilla this excessive development is generally situated in the incisor region, producing anterior protrusion; and in the mandible the same condition produces protrusion of the lower teeth, and in excessively developed cases the true "underhung bite."

Irregularities are frequently met with in idiots and in the deaf and dumb. In one case under our notice hemi-atrophy, probably of central origin, was well marked not only in the mouth but also in other parts of the body.

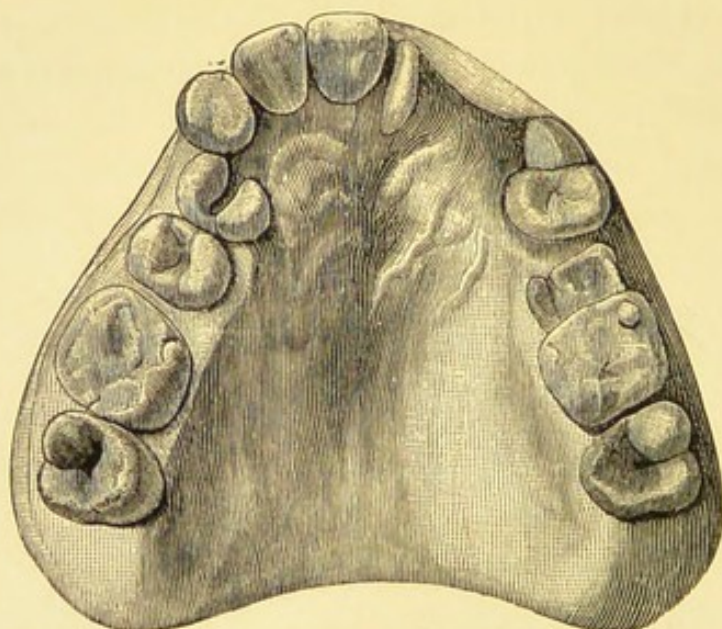


FIG. 31. Showing partial arrest of development in the region of the left incisors and canine. (From specimen in the possession of Mr. C. Robbins.)

Local causes.—*Undue persistence of the temporary teeth* is a frequent factor, by causing obstruction to the eruption of the permanent tooth. A tooth generally finds its way to the surface in that region where least resistance is offered, and the presence of the unabsorbed fang of the deciduous tooth is quite sufficient to cause a change in the normal direction. Good examples of this latter are seen in those cases where persistent temporary incisors cause the permanent ones either to erupt behind them (more rarely in front) or to rotate them upon their axes (fig. 31).

In temporary teeth, where the pulps are dead, it has been noticed that their fangs are absorbed with much less rapidity than are healthy ones.

Too early extraction of the deciduous teeth is a common source of irregularity. Removal of the temporary molars, especially the

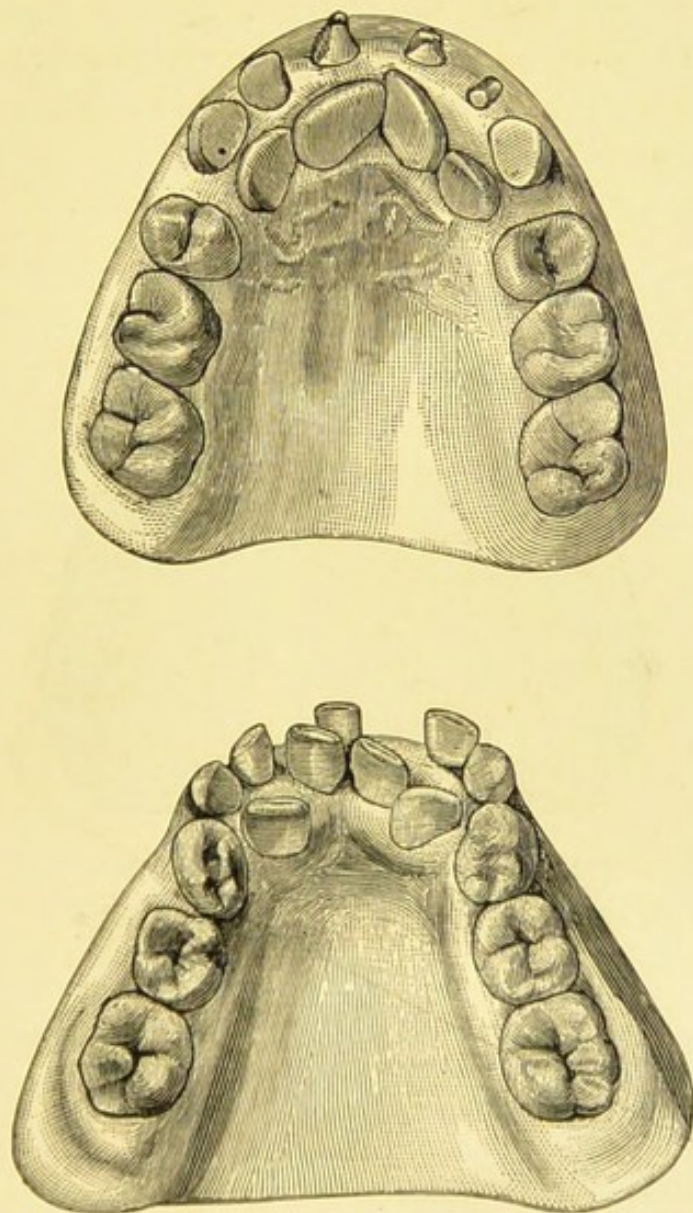


FIG. 32.

second one, permits the first permanent molar to travel forward, which necessarily gives rise to crowding anteriorly, generally resulting in the eruption of the canine high in the arch, or

less commonly of the second bicuspid in the palate. The last tooth to be erupted is the one which takes an abnormal position, and, in the case of the bicuspid, causes the "saddle-shaped arch." This may be either unilateral or bilateral.

In most cases it is advisable to retain the temporary canines as long as possible, as their early extraction allows the first bicuspid to approximate the lateral, causing the permanent canine to erupt generally external to the arch, though occasionally it may appear internal to the arch; but this subject will be dealt with more exhaustively further on.

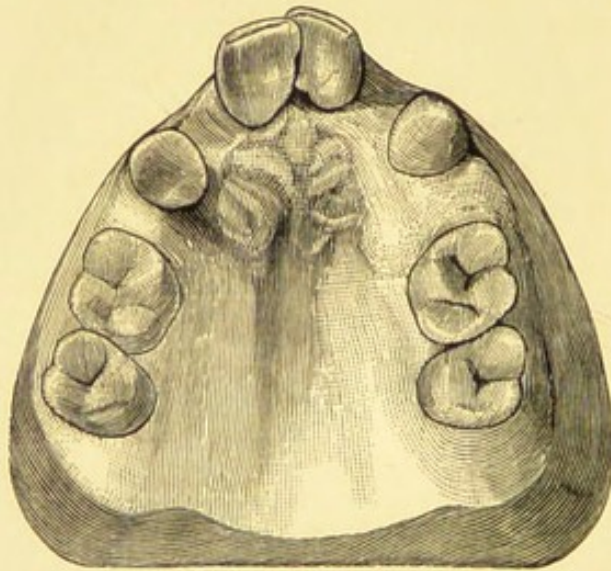


FIG. 33. Showing the result of premature extraction of the bicuspids.

The extraction of the first permanent molar before the eruption of the second one causes mastication to be carried on by the front teeth, leading to a protrusion of the upper ones—an irregularity extremely difficult to remedy.

A separation is sometimes found between the two central teeth, caused by the *frænum of the lip* passing between these teeth and being attached to the mucous membrane covering the palate. As long as this is present it is impossible to produce an approximation of the teeth.

Supernumerary teeth also cause irregularity by displacing the

teeth either inside or outside the arch, or may cause them to rotate. A peg-shaped supernumerary is frequently found between the central incisors, and invariably causes divergence of these teeth (fig. 24). In such cases, even though the supernumerary tooth be not erupted, its presence may be suspected should the frænum of the lip not prove to be the cause of the divergence. The following figure shows a case where a supernumerary had erupted prior to the central incisor, which it caused to appear outside the arch.

Thumb, lip, tongue, and toe sucking produce irregularity. Thumb sucking gives rise to a characteristic deformity—the upper teeth, and the alveolus, being displaced upwards and outwards, forming a sort of secondary and smaller arch, which is more marked when unilateral; the lower teeth are little if at all affected, which is due to the fact that the child keeps its mouth open owing to unwillingness to inflict pain upon itself, which it would do if it closed its teeth upon its own thumb. Another abnormality is produced by the child having its first and second fingers which it sucks hooked over the lower teeth. A protrusion of the lower front teeth is produced by this habit, owing to the traction thus exerted by the weight of the arm. Tongue sucking leads to prominence of the upper front teeth, and this protrusion may be retained by the teeth falling outside the lower lip.

Alveolar abscess in connection with temporary teeth leads now and then to irregularity in position of the permanent ones, because the abscess may cause displacement of the permanent tooth follicle.

Mouth breathing, due in many cases to some form of nasal obstruction, *i.e.* enlarged tonsils, or adenoid growths in the nasopharynx, has been said by several authors to be the cause of the saddle-shaped arch, their explanation being that slight pressure is brought to bear upon the erupting teeth by the buccinator muscle when the mouth is slightly opened. This does not altogether commend itself to the authors' views for the following reasons—slight opening of the mouth does not cause contraction nor tension of the buccinator; if a mouth be ex-

amined when it is slightly opened, it is apparent that there is neither tension nor pressure present; if due to pressure, it would be expected that more of the arch than the bicuspid region would be influenced. A large number of patients have been examined with the following results:—Adenoid growths and enlarged tonsils are usually found in children when the physique is below the normal standard, especially the strumous. There is a general want of tone about the muscular system, the tissues being soft and flabby, and the child generally of a lethargic disposition. In this type of child it is not surprising if we find that the want of development and tone, which is exhibited in other parts of the body, should also show itself in the dental region. This would naturally give rise to crowding; there would be a deficiency of space for the bicuspids, and in their endeavour to erupt into this smaller space, they would be forced into such a position that the natural contour of the arch would be interfered with, causing them to become erupted nearer the median line of the mouth.

A small mandibular arch may produce irregularity by allowing the lower front teeth to close on the gum behind the cingulum of the upper incisors, causing the latter to assume an oblique direction so as to rest upon the lower lip. This irregularity is also produced by too early extraction of the first permanent molars.

Cicatrices, the result of injury, especially those occurring after burns, lead in some cases to serious deformities. *Hypertrophy of the gums, exostoses of the bones, and other tumours, such as the various epulides*, etc., also act as a local cause of irregularity.

Classification.—It is not possible to give any general classification of irregularities which will include every variety met with, but for convenience the following will be found useful and practical in considering the subject:—

- (1) Irregularity in the position of individual teeth.
- (2) General crowding.
- (3) Contracted arch—(a) The **U**-shaped arch; (b) the **V**-shaped arch; (c) the saddle-shaped arch.

- (4) Anterior protrusion of the upper front teeth.
- (5) Protrusion of the lower teeth ("Underhung bite").
- (6) Non-occlusion of front teeth.

Before proceeding to deal with the above classification in detail, it will be advisable to consider some general principles that should guide the dental surgeon in dealing with these cases.

General principles involved in treatment.—In all cases *models of the mouth should be obtained* before an opinion is expressed as to treatment; indeed, in cases which come under our care at an early age, it is desirable to take models periodically, in order that it may be seen what course nature is likely to adopt. Often cases which appear at first sight to present abnormality may remedy themselves to a large extent without mechanical treatment.

Irregularities may be prevented by *careful supervision of the mouth* during the period of dentition. As a general rule, it may be said that the temporary teeth should be retained *in situ* as long as possible. All caries that may occur should be treated by filling. Undue extraction of the temporary teeth is thus avoided, and the permanent teeth prevented from erupting or travelling into abnormal positions; on the other hand there are cases where early extraction is beneficial. Examples of this have already been given on page 16.

Several important considerations must influence us in recommending treatment. One of the most important is the *age of the patient*, for it is undesirable to undertake a lengthy and tedious method of treatment at an early age, as the health of the child may be seriously affected by such methods, while if the patients be allowed to become more fully developed the strain upon them will be more easily borne. On the other hand, there are a few cases which must be treated early. The best example of this is when an upper incisor is erupting within the bite. The best age for commencing mechanical treatment is after the eruption of all the teeth except the third molars. Cases presenting themselves for treatment at an adult age should be undertaken with great

caution, the teeth at that age being far more difficult to move and retain in a new position.

The general health and temperament of the patient should influence the advice given to the parents. Surgical treatment is to be preferred to mechanical, for the strain of a long course of treatment might produce serious results in delicate children.

As it is of importance to the dentist that he should have the hearty *co-operation not only of the parents, but also of the patient*, when this cannot be obtained, it is better not to undertake the case. Some children, especially boys, are particularly refractory, and immediately they are left to themselves remove the plate from their mouth to their pockets. The *sex* of the patient is also of importance, for æsthetic considerations are of greater importance to the girl than to the boy. In the latter case it is often possible to remove front teeth which would be inadvisable in the former.

The facial expression and features will often guide us in our decision: for instance, it would be unwise to attempt expansion of the arch in a girl with a small mouth and generally small features, all of which are in harmony, as such treatment might spoil the beauty of the face; or to remove the canines, which produces flatness of the upper lip over the canine eminence, giving the face an inane expression.

The character of the teeth is an important point to be considered, for in cases where the teeth are of a delicate structure, mechanical treatment is contra-indicated, as the result of such treatment would be more disastrous, primarily to the teeth themselves, and secondarily to the general health of the patient, than leaving the irregularity untreated. *The teeth* should be *examined for caries*, especial care being taken to discover any cavities on approximal surfaces; and all decay should be treated before any mechanical appliance is inserted.

The direction of the roots of the teeth must also be ascertained. If this is not done, a tooth after being treated will in some cases slope to such an extent as to look more unsightly than before

treatment was commenced. Fig. 34 is a diagrammatic representation of the manner in which a tooth moves when regulated. It will be seen that the tooth swings upon its apex, and does

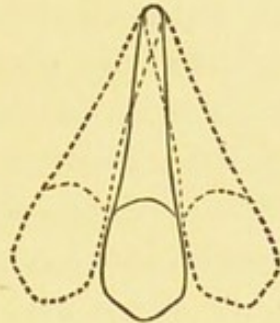


FIG. 34.

not move bodily. Attention to this point in treatment, especially of the canine, will often save subsequent disappointment.

A careful examination of the mouth must be made with a view to ascertaining the relation of the alveolar border and teeth to the body of the jaw. In some cases the alveolus appears to have been developed in such a position that the teeth already have a slight tendency to slope outwards, which is normal, although the arch may be contracted; in similar arches, on the other hand, the alveolus may be in such a position that the teeth slope inward towards the median line (see figs. 35 and 36). Cases of the

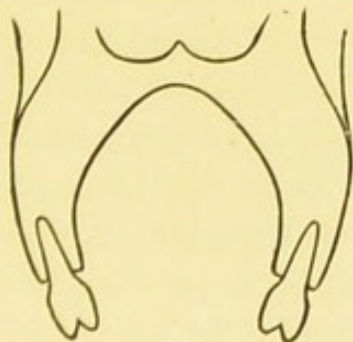


FIG. 35.

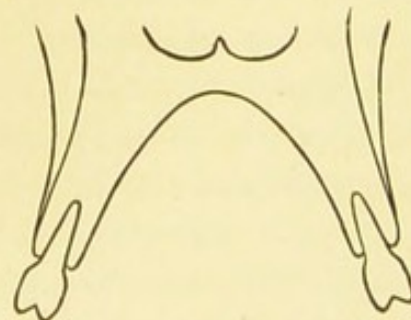


FIG. 36.

character illustrated in fig. 35 should be treated by expansion, while this is inadmissible in those shown in fig. 36.

Heredity, as pointed out above, is a constant cause of irregularities which are less amenable to treatment, and, even when righted, have a great tendency to revert to their original position.

The process by which teeth right themselves, when space allows, has been called "*travelling of the teeth.*" Perhaps the best illustration of this is met with in those cases in which there is a tendency to crowding in the bicuspid and canine region, and, when the first molar is removed, the second molars will travel forward, while the canine and bicuspids will move backwards.

In all crowded mouths one of the first questions that will arise is whether it is desirable to treat the irregularity by *expansion or extraction*, and it is only after considering the question in all its bearings that it is possible to come to a decision. Expansion in suitable cases is to be preferred, but the method of treatment is lengthy, and, consequently, if the teeth be not of good structure, the use of plates for a long period, as is necessitated by this method, can only act prejudicially upon the teeth.

Parents are frequently anxious that their children's mouths should be treated without extraction, but, in the large majority of cases, the treatment by extraction is by far the better method, for by this means nature is able to cure an abnormality which would have taken months or even years to rectify, by mechanical measures. In many cases a combination of expansion, in conjunction with extraction, is beneficial. We have stated above that judicious extraction is to be preferred to expansion in the large majority of cases. The following reasons justify the course recommended. It is the most rapid method; it saves mechanical interference, and this from a patient's point of view is manifestly desirable; it prevents injury to the teeth from wearing plates, which, in children that are not cleanly, is, in itself, sufficient to contra-indicate such treatment, as in a large proportion of mouths of civilised people interstitial decay is very prevalent.

All teeth treated mechanically have a tendency to return to their original position, and it must be in the experience of all dental surgeons that in teeth which undergo long mechanical treatment,

pathological conditions of both periosteum and pulp are very prone to arise, leading to premature loss of the teeth; and it is more than probable that in teeth undergoing this lengthy process absorption of the tooth substance occurs, as well as absorption of the bone in which they are embedded. This statement is supported by the fact that, in teeth which have been examined microscopically, after they had undergone mechanical treatment, absorption of the roots, and deposit of secondary dentine in the pulp chamber, were well marked.

Having decided that it is desirable to treat a case by extraction, it will then be necessary to *decide which tooth or teeth shall be sacrificed*. All the teeth being sound, it is best to remove those as near as possible to the seat of irregularity. When caries is present it is better to extract the carious tooth if a good result can be obtained by so doing. It is very rare indeed that it is necessary to remove either a central incisor or a canine. A large proportion of cases are met with which can be treated by extraction of the lateral incisors, particularly in the mouths of boys. With regard to the removal of bicuspids and molars for crowding in the front of the mouth, it is of importance to consider the relative value of the two teeth. If all the teeth are sound, a bicuspid, being nearer to the seat of deformity, should be sacrificed in preference to a molar, because this tooth is physiologically the more important, presenting the larger area of crown surface, admirably adapted for mastication, and the upper one so situated in the malar process of the maxilla that it is well able to bear the strain which mastication imposes upon it. On the other hand, this tooth is more prone to early decay than the bicuspids, but in many cases, if it is carefully filled, it may be retained. The question as to which bicuspid to remove, the first or second, also requires a passing notice. Statistics point to the fact that the second bicuspid is, if anything, more liable to caries, and for that reason should be extracted; considering, however, the fact that the case will in all probability be more quickly corrected by extraction of the first, and also that the liability to caries

is nearly equal, we are inclined to advise extraction of the first in preference to the second in the majority of instances. There are a few cases in which the second can sometimes be extracted with advantage, viz., where room is required to the extent of about half a tooth. If the first bicuspid is removed a space will remain between the canine, when it comes into place, and the second bicuspid, which in a girl will look unsightly; in these cases the second bicuspid can be extracted with advantage, as the space will then occur between the first bicuspid and the molar, and naturally will be less visible. *When employing extraction as a remedy for irregularity the condition of the bite should be kept clearly in view, endeavouring if possible to extract in such a manner that nature herself will remedy the deformity without mechanical aid.* When removing a tooth in either jaw it is as well, in most cases, to remove the corresponding opposing one; this is especially so with the first permanent molars. If a normal articulation is examined, it will be seen that the surfaces of the bicuspids present practi-

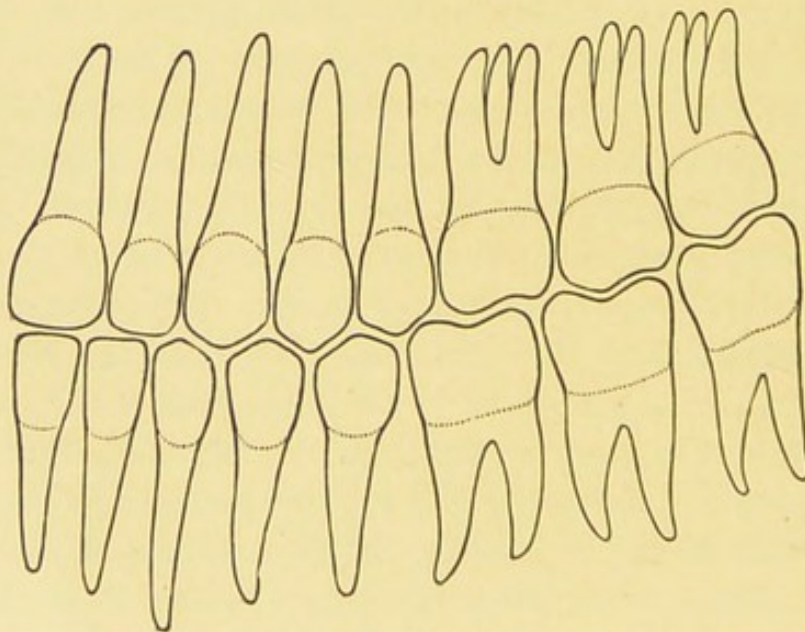


FIG. 37. Diagram of a normal articulation.

cally two planes, the one anterior and the other posterior—the anterior of the upper opposing the posterior of the lower. Each

act of mastication brings pressure upon these surfaces, and as long as the arch remains intact the resistance both in front

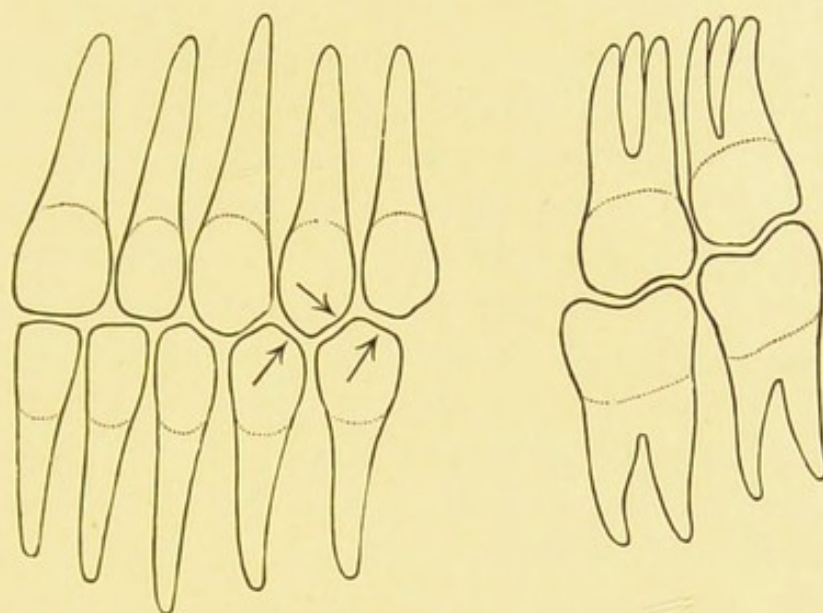


FIG. 38. Diagram illustrating the manner in which the bicuspids move backwards after extraction of the first permanent molars.

and behind will remain equal, and therefore the position of the teeth will not alter. Should, however, the resistance in either direction be removed by extraction, then each act of mastication will tend to drive the teeth in the direction of least resistance. When the first permanent molars are extracted the travelling of the bicuspids backwards is brought about as follows:—The posterior plane of the second lower will act upon the anterior of the second upper bicuspid and drive it back, the posterior plane of the first upper bicuspid driving back the second lower bicuspid, and so on. In such cases as these regulation plates can to a great extent be abandoned. Many are opposed to this line of treatment. The best answer to this is to consider a case in which, perhaps, only the molars in the maxilla have been extracted. On carefully inspecting the bite, it will be seen that the lower molar is practically no use since the opposing tooth has gone; still more, it will be seen that the second upper bicuspid is locked, and hence will require

mechanical aid to force it back, and when brought back will articulate with a molar crown surface, and will be of modified utility (fig. 39).

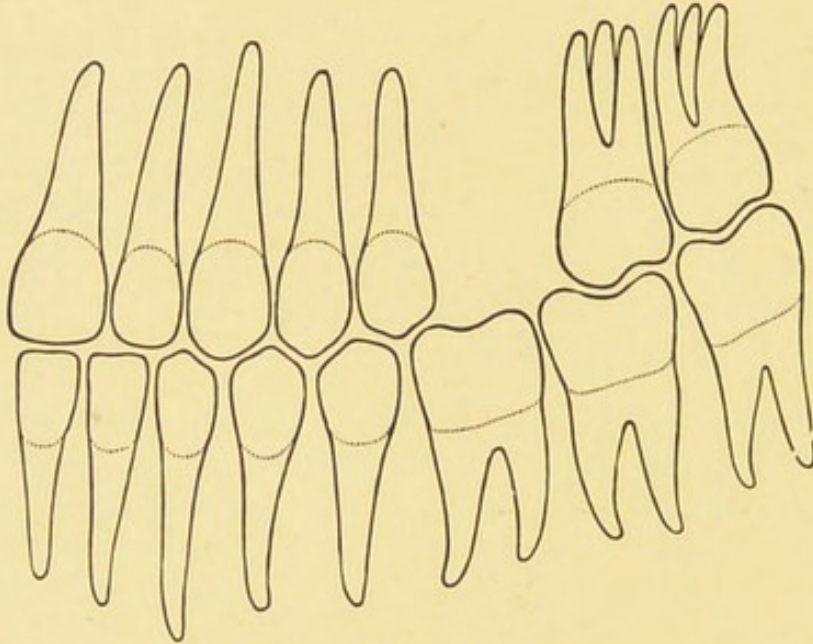


FIG. 39.

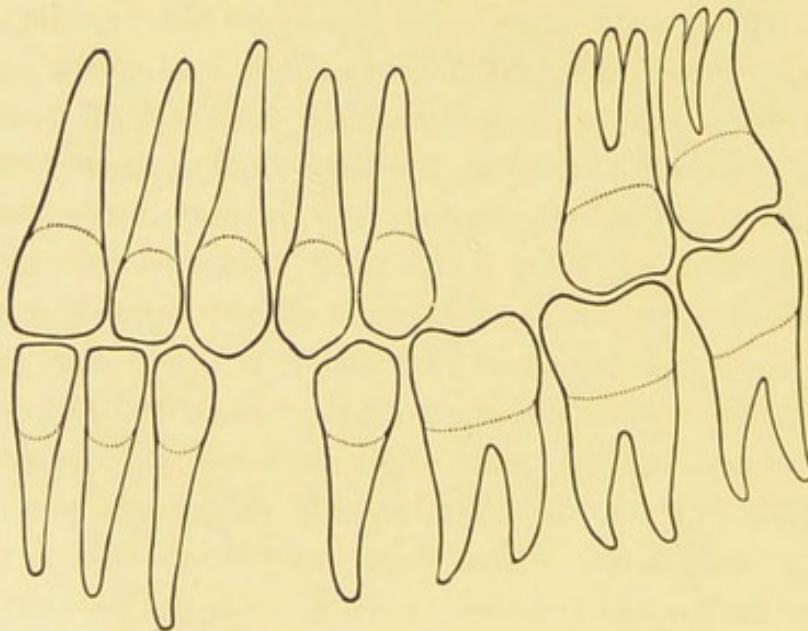


FIG. 40. Diagram illustrating the disadvantage of extracting dissimilar teeth in opposing jaws.

Extraction of dissimilar teeth in the opposing jaws is advocated, but the disadvantage of this will readily be seen by considering

a case in which say the first permanent molar has been removed in the upper and the first bicuspid in the lower jaws. Here not only shall we have all the disadvantages just pointed out, but the first upper bicuspid will also be robbed of its antagonising masticating surface. Extraction according to this plan is therefore to be avoided when possible.

When there is approximal decay upon the anterior surface of the molars, and it is decided to retain them, the second bicuspid should be extracted in preference to the first, as this will allow the filled surface of the molar to be well cleansed.

Symmetrical extraction is generally to be advised, because unilateral extraction allows the teeth on that side to travel, and so places the line between the two central incisors out of the centre of the face. In a case recently under treatment this was well exemplified. An upper tooth on the right side and a lower tooth on the left side had been removed, with a result that in the maxilla the teeth inclined to the right side and in the mandible to the left side, producing a disfigurement when the patient smiled which, to say the least of it, was undesirable.

It having been decided that a case should be treated mechanically, a choice must be made of the several methods in vogue. *In order to allow of a tooth being moved it is necessary to have a point of delivery*, which should be a fixed one, the resistance of which must be greater than the tooth to be moved. In Great Britain this is generally obtained by means of a well-fitting plate; fixed to this is the mechanism by means of which the tooth is to be moved, which may be either obtained from screws, wedges, inclined planes, or the elasticity of metals and rubber. The force applied must be continuous, steady, but not too strong, in order that absorption may be induced; if too much pressure is employed inflammation of the periodontal membrane may supervene, and even death of the tooth, by the strangulation or rupture of the vessels entering the apical foramen. *The phenomena that occur in the alveolus during the movement of a tooth* are these: the alveolar wall against which the pressure is indirectly

applied undergoes absorption, and when the tooth has moved into the position required, and is retained there firmly by artificial means, a fresh deposition of bone takes place, forming a new socket. Thus it is possible to move incisor teeth quickly outwards, as the outer alveolar plate is thinner, and there is less bone to be absorbed.

In the majority of cases it is advisable to use vulcanite for the regulation plate, because a better fit can be so obtained, it can be more easily and quickly made, and it is easier to remedy any error in articulation that may occur in the process of manufacture. If the teeth are capped the articulation should be so regulated that the plate can be made comfortable for the child to eat with. For this purpose a model of the lower teeth should in all cases be taken. Regulation plates should not be tied in, and should be made in such a way that the patient can easily remove and replace them.

The patient should be advised to carefully brush the teeth and plate after every meal, and it is a good practice to place the plate in a solution of bicarbonate of soda during the period occupied in using the tooth brush. If during the employment of regulation plates the gums surrounding the teeth become inflamed, a local application of the lin. of iodine, the tinct. of aconite and chloroform, equal parts, is often beneficial, and a mouth wash of permanganate of potash should be used, a convenient form being Condly's ozonised water.

For the purposes of treating one case it is often necessary to make several plates.

There is a method freely used in America, which is only mentioned to be condemned, viz., *the use of fixed apparatus*, although it is true that the patient may be saved many visits from the fact that they can adjust it themselves. On the other hand, the mischief brought upon individual teeth more than counterbalances the benefits to be derived, for no matter how accurately a band, which is not removed for the purposes of cleanliness, may be made to fit round a tooth, it must in a very short period produce destructive processes in the tooth to which

it is attached. The apparatus, shown in fig. 41, has the advantage of being small, for it consists usually of a band adjusted to a back tooth, which is supposed to be the fixed point, while another is

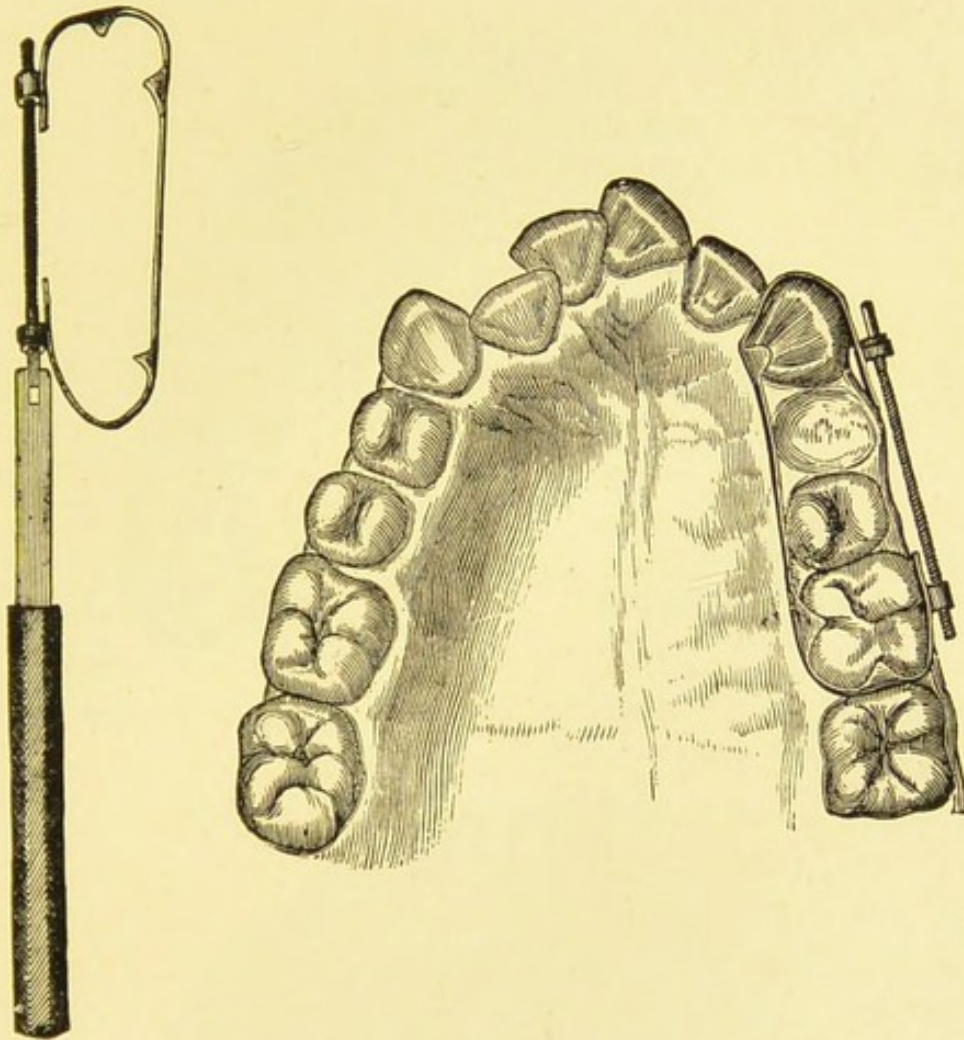


FIG. 41.

attached to the tooth to be acted upon ; these two are joined in such a manner that by means of a small screw they can be approximated or separated, but it is very doubtful whether the back tooth always remains as a fixed point. Fig. 42 illustrates another variety of this form of regulating apparatus.

Of the forces employed in moving a tooth, the screw is sometimes used, a powerful form being that known as the jack-screw, the mode of using which is shown in fig. 43. It is best used in cases where great resistance has to be overcome, as in the case of

an upper canine erupted within the bite. The screw is useful when the child cannot be frequently seen, the patients being able themselves, after a little instruction, to move the screws by means

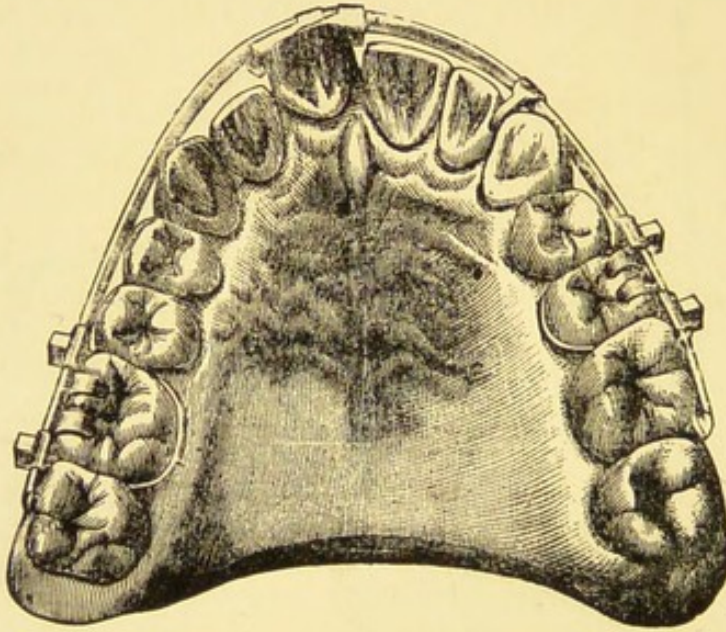


FIG. 42.

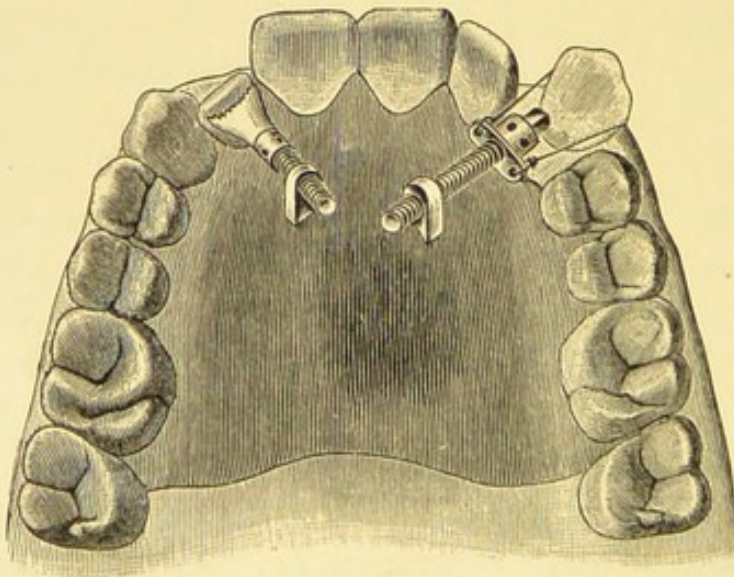
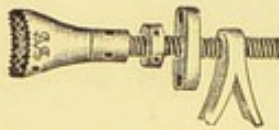


FIG. 43.

of a small screwdriver or spanner. This method is illustrated in figs. 44 and 45, the former being a plate employed for pushing out teeth, the latter for retracting them.

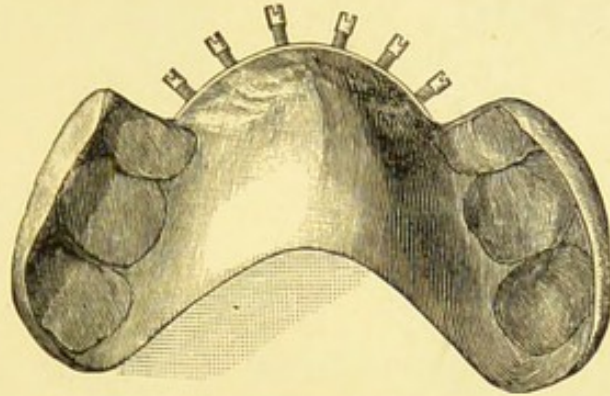


FIG. 44.

Wedges are much used by some operators. The best form is hickory wood compressed laterally, which is used in the following way. A double dovetailed slot must be cut in the plate in a line with the direction in which it is desired to move the tooth,

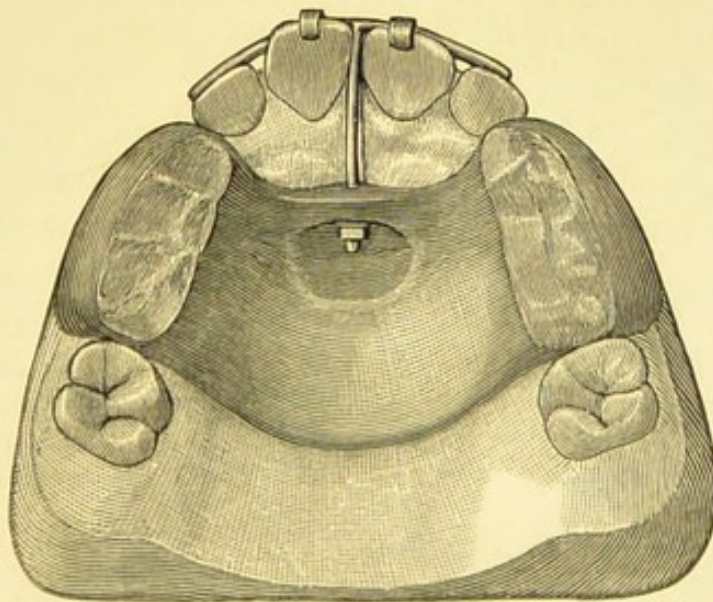


FIG. 45.

one broad end of the dovetail forming the base against which the resistance will come, and the other broad surface being

directed towards the palatal side of the plate. The slot is now filled with hickory, which must be so inserted, that one of the compressed sides will be in contact with the broad base of the slot and the other impinging on the tooth—in other words,

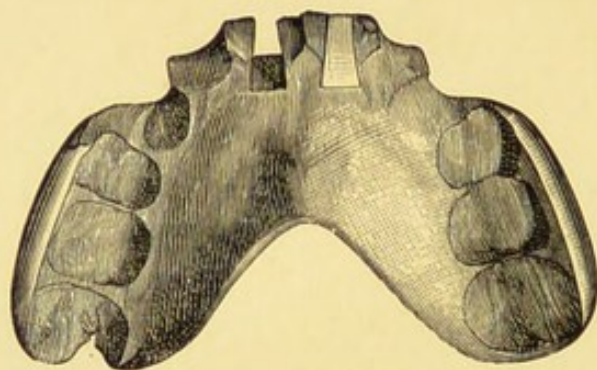


FIG. 46.

the long axes of the fibres at right angles to the line in which it is desired to exert the force. With the access of moisture the wood will tend to resume its original bulk and move the tooth in the desired direction.

Another form, often spoken of as wedging, depends for success on a favourable slope on the surface of the tooth, and not upon any expansive force of the material used. A slot or hole is made in the plate, into which is inserted a peg of vulcanite or wood which is left too long to admit of the plate being at once forced into position. This peg will at first impinge upon the tooth near its cutting edge, but by the force of the lower tooth closing, both plate and peg will be carried up to the neck of the tooth, and according to the difference in thickness of the tooth at these two points so is the movement of the tooth. It must be borne in mind that little or no increase in length of a wooden peg takes place from the inhibition of moisture, and the more rigid vulcanite is in many ways preferable.

Inclined planes are useful in certain cases, a good example being when it is required to push out one, two, or more of the upper incisors. For this purpose a small plate covering the lower

teeth is made; on the anterior surface an inclined plane is fixed in such a way that when inserted the teeth to be



FIG. 47. Lower plate, with inclined plane on right side, used for pushing out an upper canine.

moved impinge upon the upper part of it, and each act of mastication or closing the mouth tends to drive the upper teeth forward. This plan is not now much used, but nevertheless, in properly selected cases, is valuable.

Elastic bands were much in use at one time, but fortunately they are now seldom employed, and their general use is to be deprecated, as there is nothing that can be done by elastic rings that cannot be accomplished with better results by other means. The great danger attending their use is their tendency to slip up the tooth, and so cause local inflammation, and ultimate loss of the tooth. Many cases have been reported where injury has been caused by their use, and it is time, unless something more can be urged in their favour than is at present before the profession, they should be relegated to the methods of the past. If, after the above remarks, it be felt necessary to use these rings, every care must be taken to retain them in such a position on the tooth that no harm can arise. This may be accomplished by hooks, or by fixing the bands with some oxyphosphate cement to the crown of the tooth.

Within recent years advantage has been taken of the springiness of various metals, more especially of *pianoforte wire*, and this if properly arranged can be used in a large number of irregularities, for by its means a tooth can be forced outwards, drawn backwards, or rotated. The pianoforte wire used should not be too stout, as with thick wire the spring is much less marked. The advantages it possesses are that the pressure is

constant, can be easily controlled, that it is more cleanly and less cumbersome than many other materials, and that the position of the wire can be readily changed. The accompanying figures (figs. 48 to 57)¹ show the various uses to which this form of wire can be put. But each case must be treated on its own merits.

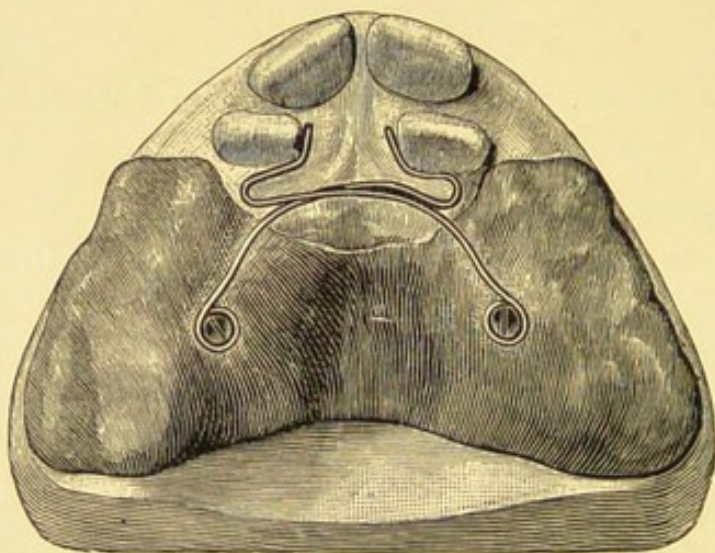


FIG. 48. Plate for pushing lateral incisors outwards and forwards.

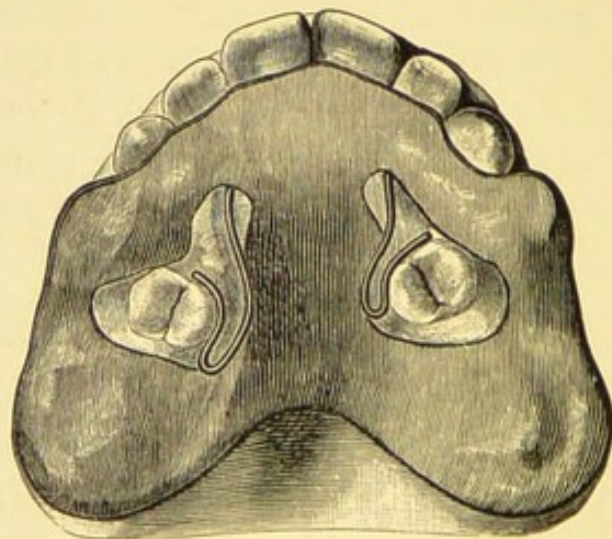


FIG. 49. Plate for pushing bicuspids outwards.

¹ For the design of these plates we are indebted to the kindness of Mr. L. Read.

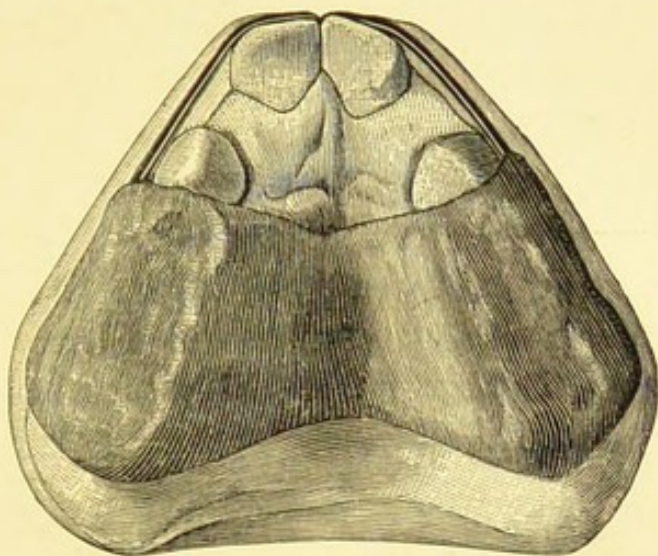


FIG. 50. Plate for retracting front teeth.

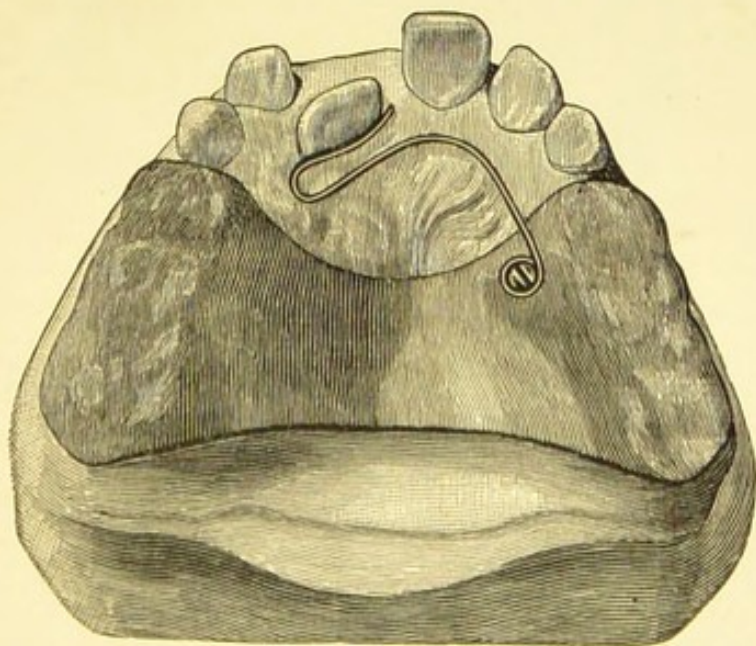


FIG. 51. Plate for pushing out an upper incisor.

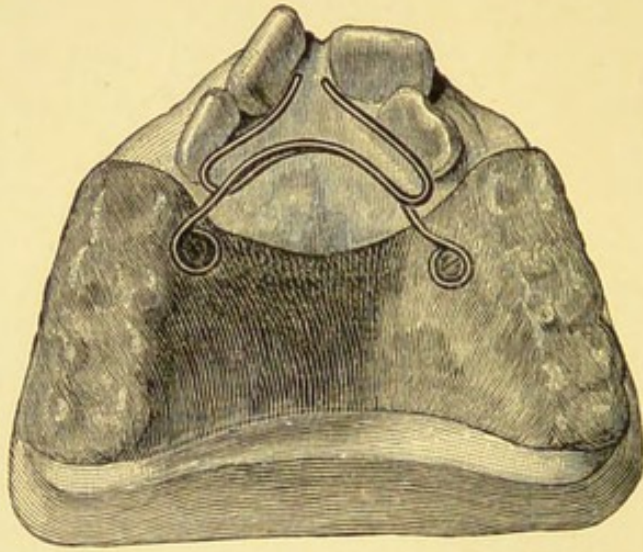


FIG. 52. Plate for bringing the four incisors into the line of the arch.

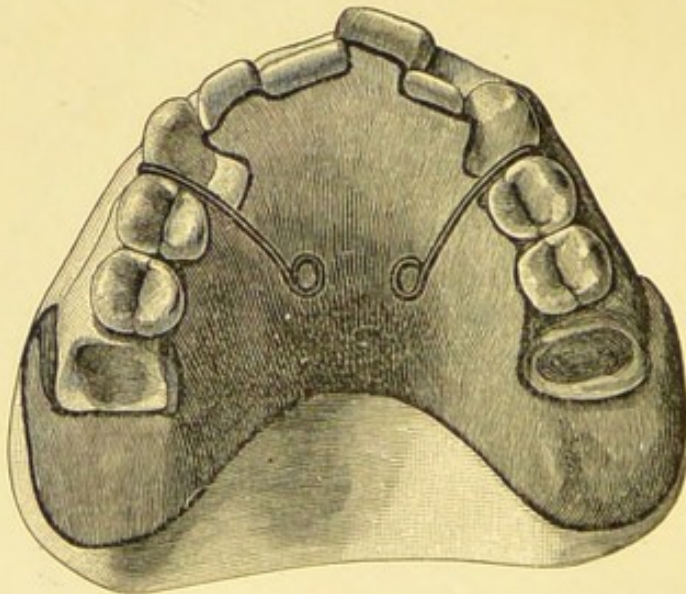


FIG. 53. Plate for drawing back bicuspids.

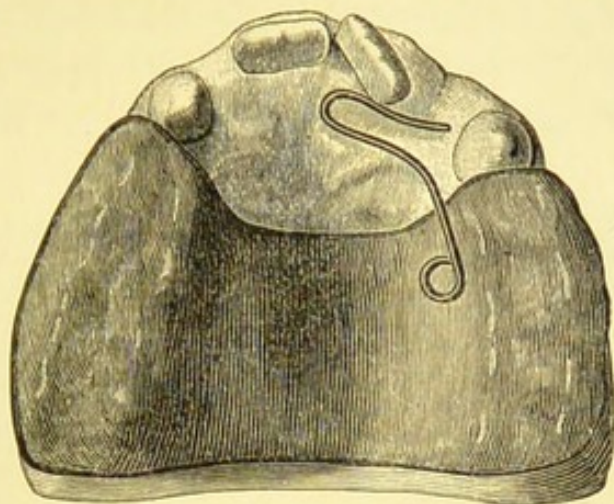


FIG. 54. Plate for pushing the distal side of an upper central over the lower teeth, and at the same time slightly rotating it.

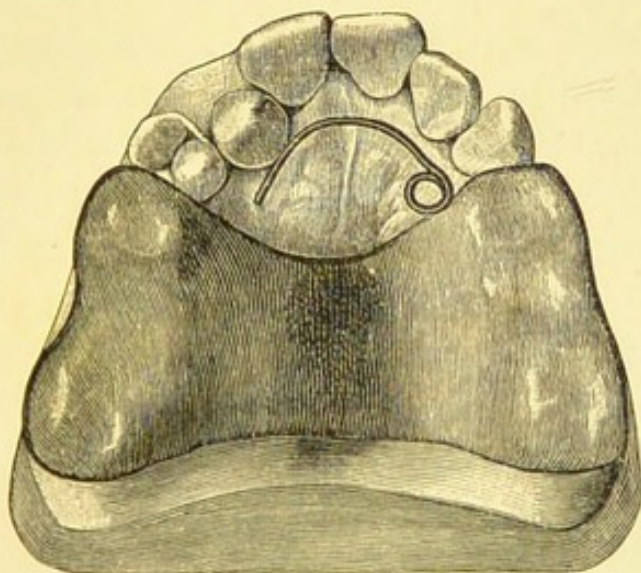


FIG. 55. Plate for pushing out a canine.

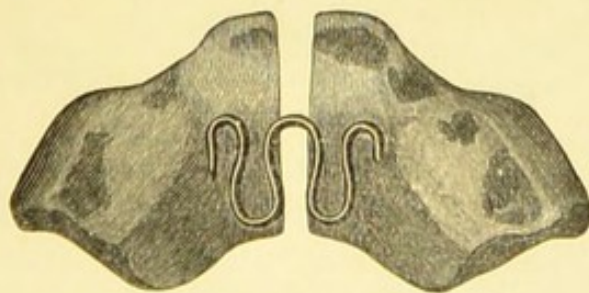


FIG. 56. Plate for expansion of the arch.

E

Gold wire is not so universal in its applicability as the foregoing. Before it can be used for regulating purposes, it must be made springy by gentle hammering, but it cannot be made as

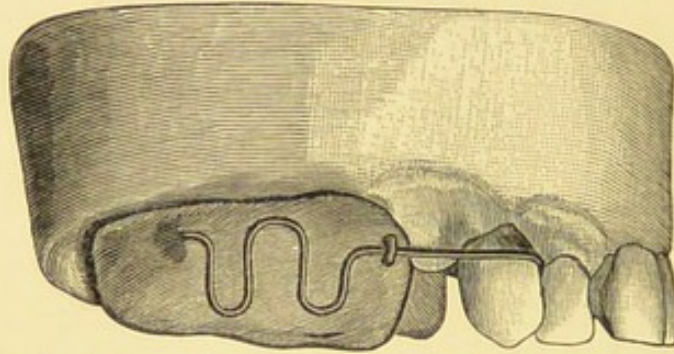


FIG. 57. Plate for drawing back an upper canine.

elastic as pianoforte wire, and it is serviceable only in those cases where great elasticity is not necessary, an advantage claimed for it being that it keeps its colour and does not blacken the teeth, as pianoforte wire does, but the staining from the pianoforte wire is only superficial and can be easily removed with a cane and pumice-powder.

For *retention plates* gold wire answers admirably, but should

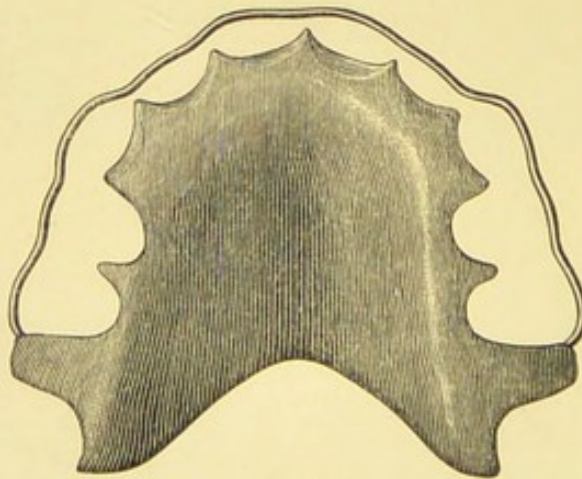


FIG. 58.

not be used too thick. Retention plates are necessary after the correction of most irregularities, and have to be worn day and

night for a period of at least six months, and in many cases it is needful to continue their use for a longer period. These plates must be removed for purposes of cleanliness at least twice a day. The general character of these plates is shown in fig. 58.

The general principles having been considered, we must next proceed to review in further detail the classification already given.

(1) **Irregularities in Position of Individual Teeth.**

(a) **Upper incisors.**—The more common irregularities of these teeth are either that they *protrude or fall within the arch of the lower teeth*. Less commonly they are found overlapping each other, rotated upon their axes, or separated from one another

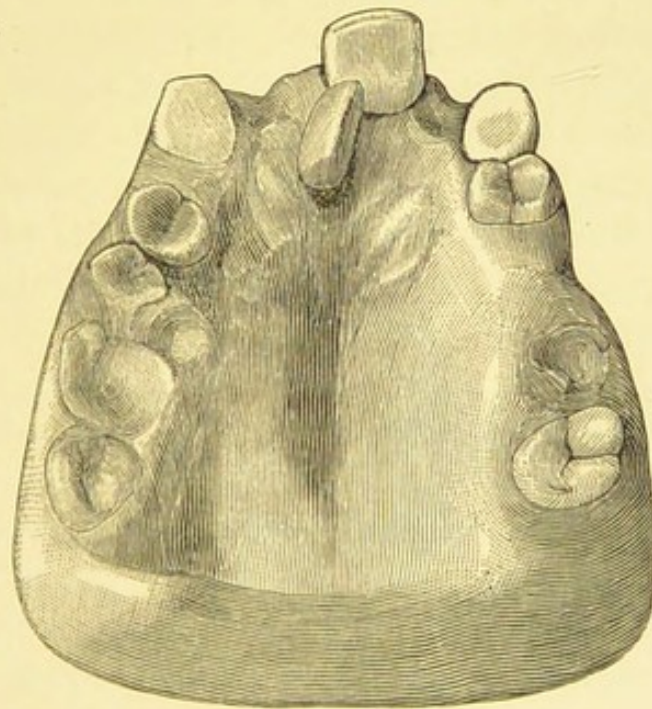


FIG. 59. Showing peculiar irregularity of upper central. From the Museum of the Students' Society of the Dental Hospital of London.

by an abnormal space. They may be transposed, that is to say, change place with a neighbouring tooth, or a tooth be so displaced that it erupts high up in the arch or in the palate.

When an incisor erupts externally or internally to the arch, it may be due to persistence of a temporary tooth. This is more

marked in those cases where the deciduous teeth are dead, for it has been shown that absorption is considerably retarded and even arrested in such teeth. In some cases the persistent teeth are quite normal, and after extraction it is found that the fangs have undergone little or no absorption; but this process must have taken place in those tissues that were superincumbent to the erupting teeth, from which it may be concluded that the tooth was developed in an abnormal position, and the direction in which it was erupted was governed by this fact, and the persistent tooth is in these cases the effect and not the cause. *The presence of supernumerary teeth* also produces this irregularity. In those teeth which are making their appearance external to the arch it is generally sufficient to remove the deciduous tooth and leave nature to complete the process of regulation, which is generally done quite satisfactorily. If this is not the case, mechanical measures must be resorted to, and a plate similar in construction to that shown in fig. 50 used.

The teeth may, however, erupt in so slanting a position that the lower lip when the mouth is at rest is placed between the upper and lower incisors, and so prevents nature doing her work. In cases of this kind a simple mode of procedure that may lead to a complete rectification of the irregularity is to tie an apron of thick rubber dam on to the irregular teeth: this apron should project considerably below their cutting edge, and so effectually prevent the lower lip from passing behind them.

Teeth that erupt internal to the arch may be treated in two ways, either by an upper plate with wires or wedges, or a lower plate with an inclined plane (fig. 47). The above irregularities cannot be treated too early, because the teeth are more easily moved before the calcification of the fangs is completed.

Rotation of the incisors is brought about by similar causes. Lateral incisors are more commonly found rotated than the central incisors. The rotation may be limited to a quarter or half a turn, and one or both teeth may be affected. When both are rotated the irregularity is generally but slight, and is symmetrical; but when the sides of the tooth present antero-posteriorly the

irregularity is generally unilateral. When both central incisors are affected the mesial surfaces may present either anteriorly or posteriorly. The lateral incisors may, like the centrals, assume almost any degree of rotation. This form of irregularity in the large majority of cases is due to want of space in the incisor region, and it is necessary in such cases to make room by extraction of the temporary canines before commencing mechanical treatment, leaving to a subsequent period the rectification of any irregularity in the position of the permanent canine which may occur, and probably would result in the removal of a bicuspid or molar. To overcome this abnormality by *mechanical methods* it is necessary to act upon the mesial and distal corners of the tooth by forces acting in opposite directions, and this may be well performed in one of several ways. *Immediate torsion may be performed*; this is the process of turning a tooth with a pair of forceps. To do this it is necessary to have a small pair of forceps accurately fitting the tooth. The forceps should then be covered with some substance such as thin lead, lint, cotton wool, and the tooth grasped firmly by the forceps in the process of turning, which should be slowly performed. Steady pressure must be made upwards, as otherwise the tooth may be removed. The tooth having been rotated should be kept in its new position by either ligatures or a retention plate. This operation should not be performed after the age of nine, as subsequently to this period the root is so nearly completely formed as not to permit of the operation without the danger of causing death of the pulp. In spite of many successful cases having been recorded, it has not received the general approbation of the profession.

Separation of the central incisors may be due to the presence of a supernumerary tooth (fig. 24); or to the attachment of the frænum of the lip to the inner side of the alveolar ridge. In many cases, however, it is impossible to discover the cause. The treatment in the first instance is to remove the cause and bring the teeth together by means of mechanical measures. The division of the frænum is easily performed with a sharp-pointed pair of scissors; a small piece should be removed and the edges

touched with potassa cum calce. In many cases the irregularity will cure itself without further aid.

Slight overlapping of the central or lateral incisors, which does not amount to real deformity, is best left untreated. It is generally due to crowding, and removal of a bicuspid will usually rectify it should treatment be deemed desirable.

There is, however, *an irregularity of the lateral incisor*, which it is of the highest importance to recognise early, since, if left to a later date, it is extremely difficult to rectify. *It consists in the mesial edge being directed forwards, and lying slightly over the central incisor* (fig. 60). This is found in small jaws, and is

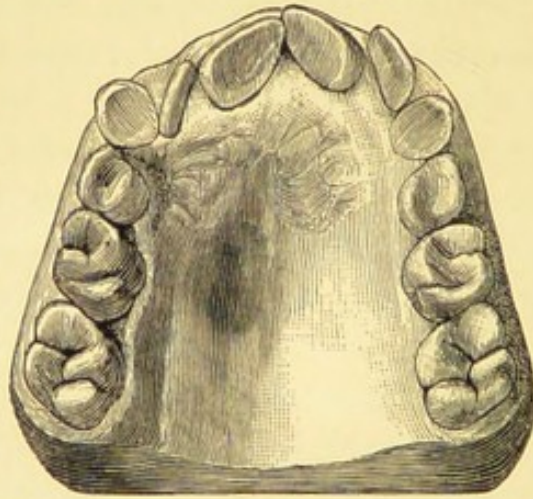


FIG. 60.

produced by the pressure of the developing permanent canine upon the root of the lateral incisor. This condition is best met by the operation spoken of on page 17, consisting in the removal of the first temporary molar and unerupted first bicuspid; which allows room for the permanent canine, and relieves the pressure upon the permanent lateral. Mr. Charles Tomes was the first to suggest this operation.

Transposition has no interest, except from an anatomical point of view, as it is beyond the pale of treatment. The central and lateral may change places, or the lateral may take the position which should be occupied by the canine.

Those teeth which erupt high up in the arch or in the palate are frequently dilacerated. When the cutting margin of the erupting tooth assumes a horizontal position it is better to remove

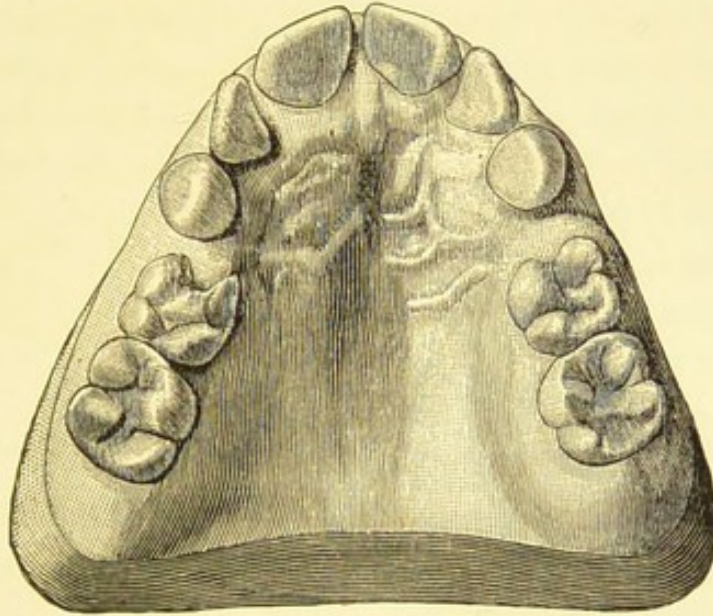


FIG. 61. The case shown in fig 60 eighteen months after treatment.

it, as it would not be possible to correct so severe an irregularity, and its presence might easily lead to a severe wound in the lip. When they erupt in the palate, they are also best removed, as

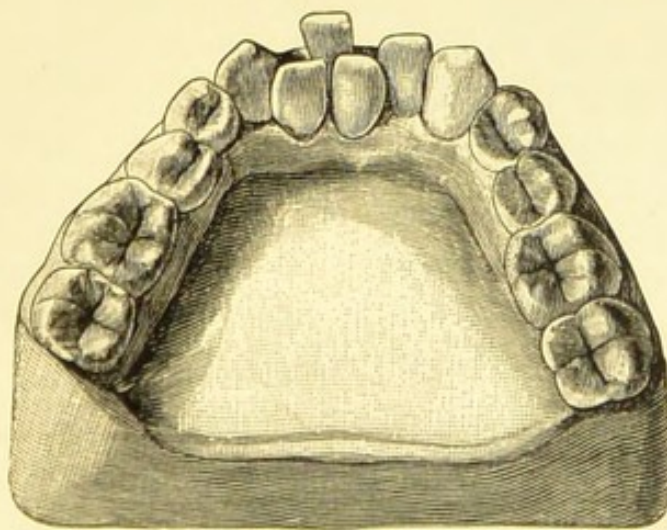


FIG. 62. Represents a crowded condition of the lower incisors.

they are a constant source of irritation to the tongue and also produce a lisp.

Lower incisors.—Irregularities of the lower incisors are not of the same importance as the upper, because they do not assume such a variety of abnormal positions and are not the cause of so much unsightliness. Occasionally an incisor is met with either external or internal to the arch, the remaining ones being regular; this is generally the result of crowding, and the best treatment for such cases is the removal of the offending tooth.

(b) **Canines.**—The canine calls for treatment perhaps more often than any other tooth, and, in considering its irregularities, it should be remembered that it is the most important tooth in the dental arch, forming a kind of key stone, and in a great measure giving character to the face. When extracted, it leaves a depression near the alæ of nose, leading to an expressionless appearance. It is the longest, and probably the strongest and best developed tooth in the whole arch; for these reasons endeavours should be made to retain it. This tooth may erupt

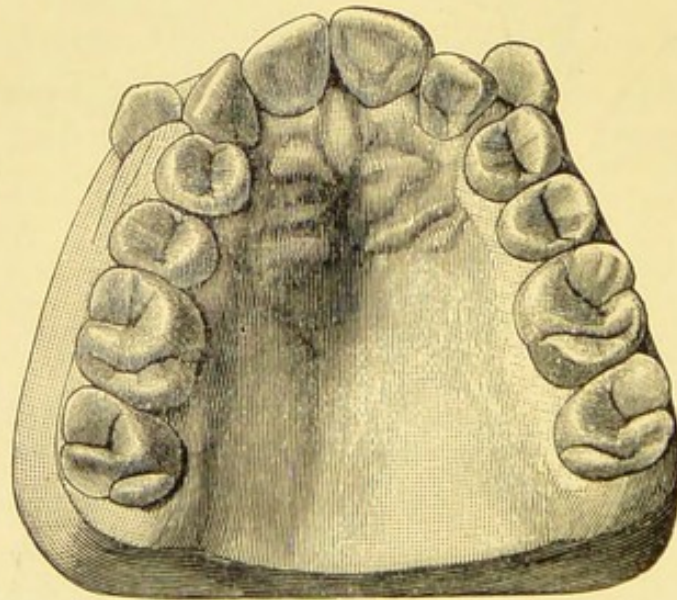


FIG. 63. Showing eruption of the canines high up on the outer side of the alveolus.

high up or within the arch. It may be rotated, and, like the incisors, transposed, or erupt in very abnormal positions.

The first of these irregularities is the one that most frequently will have to be treated, and is generally the result of crowding.

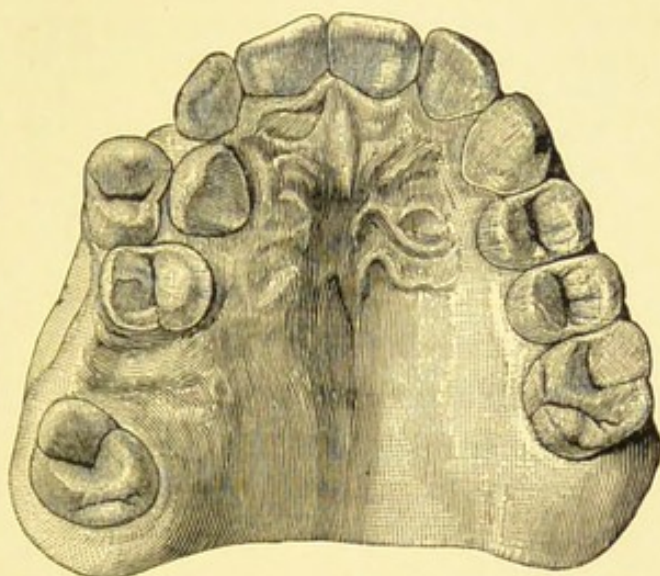


FIG. 64. A case in which the canine has erupted internal to the arch.

The treatment usually resolves itself into the questions of whether the lateral, the bicuspid, or the molar should be removed, or as a last resource the canine. In deciding upon our treatment in such cases the position of the root of the canine is of importance.

If the root has a direction forwards it is useless to remove a tooth posterior, as the canine, when it erupts, will slope very much backwards and look extremely ugly; whereas, if the lateral is extracted, the canine would erupt fairly straight, and look much better. The accompanying figures illustrate this point. The question whether a bicuspid or molar should be removed has been already discussed on page 51.

Irregularities of this tooth seldom require any mechanical treatment, especially if judgment has been exercised in extracting the teeth with relation to the bite. It is a good rule after extraction to wait for a period of three to six months and see if nature will not overcome the difficulties herself. If at the end of that period the tooth does not appear to be moving into position, some mechanical assistance can be given, and one of the easiest

and simplest methods in vogue is that shown in fig. 57. In certain cases, however, extraction of the canines is quite justifiable, especially those in which, with the arch regular, the

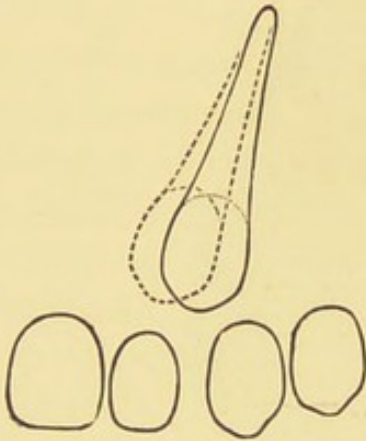


FIG. 65. Showing the root of the canine lying over the bicuspid. The dotted lines represent the direction the canine will take if the lateral is extracted.

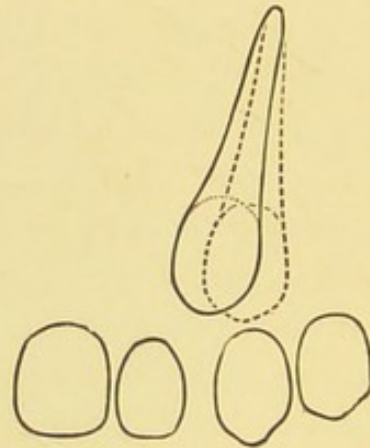


FIG. 66. Showing the root of the canine lying over the bicuspid. The dotted lines represent the direction the canine will take if the bicuspid is extracted.

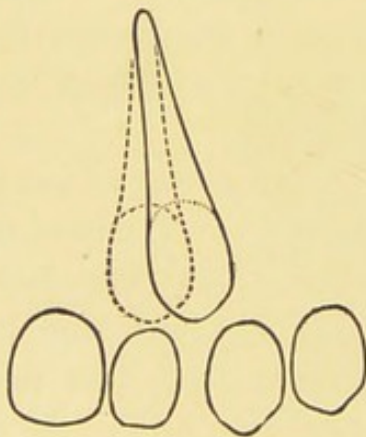


FIG. 67. Showing the root of the canine lying over the lateral. The dotted lines represent the direction the canine will take if the lateral is extracted.

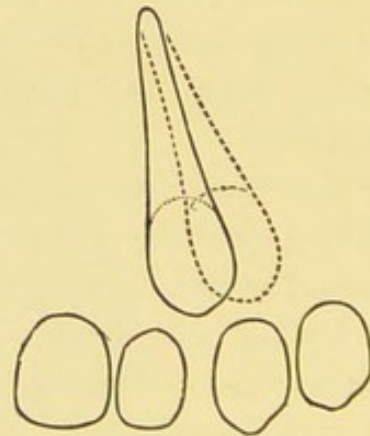


FIG. 68. Showing the root of the canine lying over the lateral. The dotted lines represent the direction the canine will take if the bicuspid is extracted.

laterals are close or fairly close to the bicuspid, and the canine erupts with a direction nearly directly outwards (fig. 69). The teeth in such cases have usually twisted fangs, which would give rise to difficulty in bringing them into

position. Under such conditions extraction is undoubtedly the best treatment.

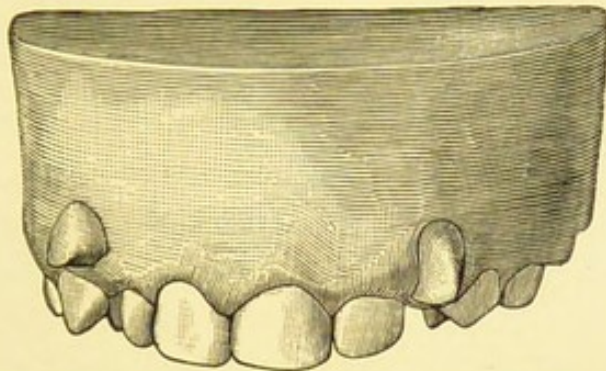


FIG. 69.

When the tooth is erupted within the arch the condition is often produced by persistence of its predecessor, or the erupting tooth may take an abnormal direction. It may also be due to

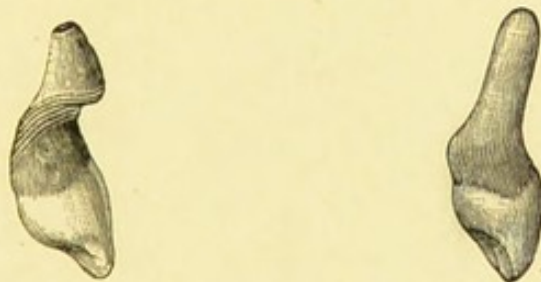


FIG. 70. Canine teeth removed from the case illustrated in fig. 69.

crowding, and in such cases there is frequently some rotation of the first bicuspid. The treatment is to make room either by the removal of the persistent tooth or a permanent one, and then push the tooth into position by mechanical means. Rotation of the canine is less frequent than that of the incisors. In treatment, torsion by the immediate method is out of the question, and when it is desirable that something should be done, it must be accomplished by mechanical methods. Transposition of this tooth is frequent. It is at times seen adjacent to the central, and in the position of the first or even the second bicuspid.

The canine is very erratic in its movement, probably on account of the position in which it is developed. Cases are on record of its appearance in very abnormal positions. It has been known to erupt into the floor of the nares; occasionally it presents horizontally, lying over the roots of the incisors. The treatment naturally consists in extraction, an operation not always of the simplest character; and, before the removal is attempted, it is as well to diagnose the exact position of the tooth.

Lower canines.—The principal irregularity of these teeth is when their eruption is external to the arch, and the treatment is generally extraction of one of the approximal teeth; and which one is to be sacrificed must be decided upon the same lines as guide us in the case of the maxilla. This tooth also presents in very abnormal positions. Fig. 71 represents a case where it

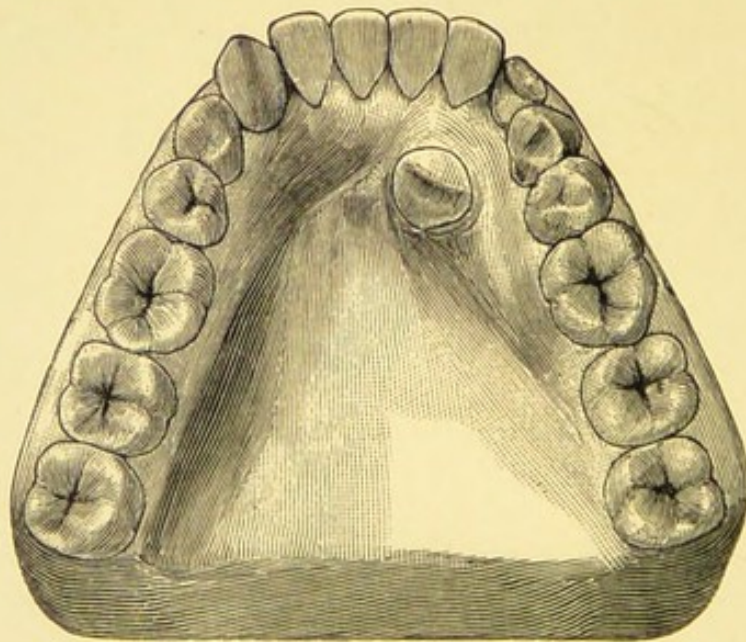


FIG. 71.

appeared in the floor of the mouth, and naturally gave rise to much irritation of the tongue; and in another recorded by Mr. Truman in the *Transactions of the Odontological Society*, vol. xxiii., New Series, page 34, the tooth appeared under the chin (fig. 72), apparently having been directed in its course by the presence of



FIG. 72. *St. Thomas's Hospital Reports*, 1893.

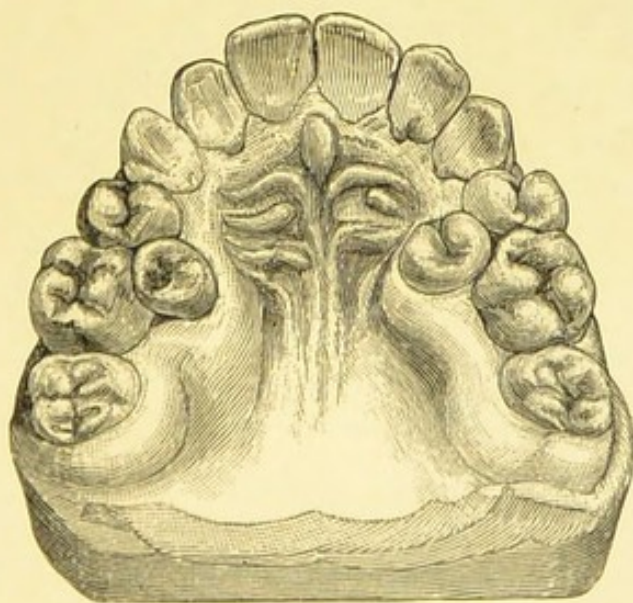


FIG. 73.

a fistulous opening, and subsequently to its removal a bicuspid made its appearance in the same position.

(c). **Bicuspids.**—Irregularities of these teeth are much the same as those of the foregoing. The variety most frequently met with is that in which they erupt within the bite (fig. 73). Crowding is

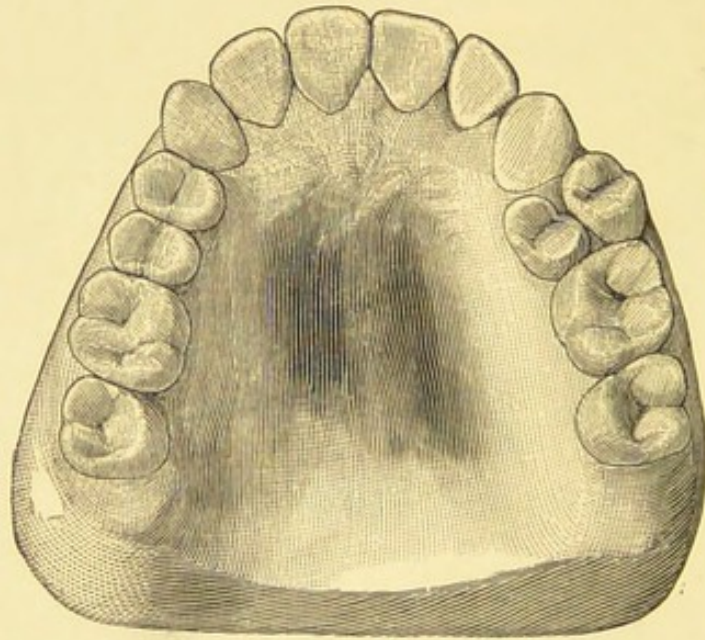


FIG. 74. Irregularity of bicuspids due to the moving forward of the first permanent molar.

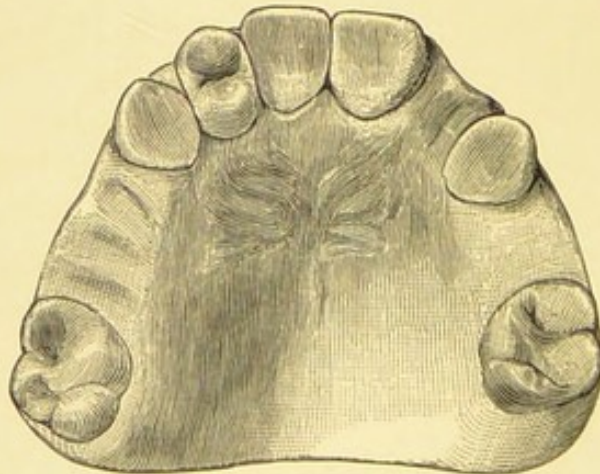


FIG. 75. Showing transposition of bicuspid.

the usual cause, and extraction the best remedy. These teeth are sometimes found transposed, and may even appear adjacent to

the central. Irregularities of the lower bicuspid are of little importance, and rarely call for treatment.

(*d*) **Molars.**—Irregularities of these are very rare, except in the case of the third, and treatment is seldom called for. A case is recorded where the three molars erupted in such a manner as to form a kind of triangle. The third molar is perhaps even more erratic than the canine in its eruption. A fairly common condition is that in which the lower one assumes a horizontal position, so that its crown surface impinges upon the back of the second molar, leading to absorption of the tooth at that part, and even producing exposure of its pulp. The crown may also take a direction towards the cheek, leading to extensive ulceration of the soft parts. In one case on record the tooth erupted at the angle of the jaw, causing ulceration through the soft tissues, and appearing on the surface.

The upper third molar may, like the lower, erupt obliquely or horizontally towards the cheek, or may be directed posteriorly towards the hamular process, and the museum of the Odontological Society contains a model with the third molar erupted in the median line of the palate.

When the above irregularities are the result of crowding, they are generally associated with a large amount of pain and inflammatory trouble. This has been referred to on page 29. The best treatment for these irregularities is the removal of the offending tooth when possible, but in some cases it is necessary to extract the second molar; particularly is that the case when the lower third molar leads to absorption and subsequent pulpitis in the second molar. The best methods for removing these teeth will be referred to in the chapter dealing with extraction.

In connection with this division of our subject, it will not be out of place to refer to those interesting cases where teeth remain embedded in the substance of the jaw; for instance, Salter figures a first lower bicuspid behind the mental foramen, the tooth being in an oblique direction with the crown upwards and forwards, while in another specimen the first lower molar is lying horizontally within about two lines of the edge of the jaw,

at a point about intermediate between the angle of the jaw and the chin.

The upper canine is a tooth frequently remaining embedded, generally lying in a horizontal position in the palate or just beneath the floor of the nose, while Mr. Tomes, in his *Dental Surgery*, p. 222, figures a canine in which the crown has taken a position upwards, pointing towards the nasal process of the maxilla.

The lower third molar is another tooth which is often totally misplaced. It may assume a horizontal position, so that its crown surface impinges upon the posterior aspect of the second lower molar, this condition frequently being symmetrical. In a specimen given by Sir Edwin Saunders to the Odontological Society, the third molar on either side of the jaw is situated in the ascending ramus with the crown nearly on a level with the second molar tooth.

The upper third molar may likewise remain buried, and very frequently is found geminated with the second upper molar (see fig. 106). In addition to the above, other teeth of the series have been found buried within the substance of the bone; but their enumeration is of no practical importance.

(2) General Crowding of the Anterior Teeth.

This condition is often seen when the bicuspid and molars are in good position, and may be produced by the following causes:—

- (1) Too early extraction of temporary teeth.
- (2) Arrest in development of the maxilla.
- (3) Excessive development—in size.
- (4) Excessive development—in number (presence of supernumerary teeth).
- (5) Eruption of the wisdom teeth.

The early removal of the second temporary molars, as pointed out on a previous page, is perhaps the most frequent cause of this irregularity, which results from the first permanent molar

travelling forward, and occupying a part or whole of the space in the arch which, in the normal condition, is occupied by the second bicuspid. The bicuspids will then erupt anteriorly to their normal position, and so encroach upon the space which the canine should fill, and may even touch the lateral incisors; the result of this being that the canine is forced either within or without the arch. In these cases where practically no room in the arch is left for the canine, it usually erupts high up, producing but little irregularity of the other teeth; but when there is a certain amount of room, so that it can wedge itself in between the first bicuspid and the lateral, a considerable amount of irregularity of the front teeth is usually the result, as, for instance, the laterals may be driven outwards, or more commonly inwards; may be partially rotated, or overlap or be overlapped by the centrals. The central incisors may overlap each other, or have their mesial or distal surfaces turned outwards or they may be forced outwards or occasionally inwards,

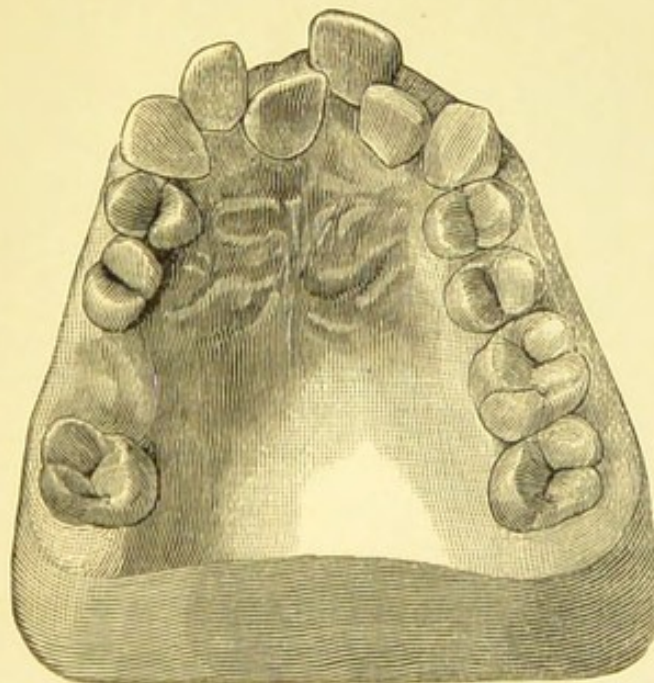


FIG. 76. Model showing general crowding of the incisors.

as shown in fig. 76. In other cases it is found that the irregularity is not restricted to one or two teeth, but has affected both

central and lateral incisors, as well as the canine. When the canine has erupted early, the temporary molars having been removed, the eruption of the bicuspid in a space slightly too small for them will lead to similar conditions.

All that has been said above is equally true concerning the mandible, except that the irregularity of the front teeth is modified, the upper, as a rule, preventing them being much displaced, and the irregularity generally amounts to slight twisting and overlapping or prominence of the incisors.

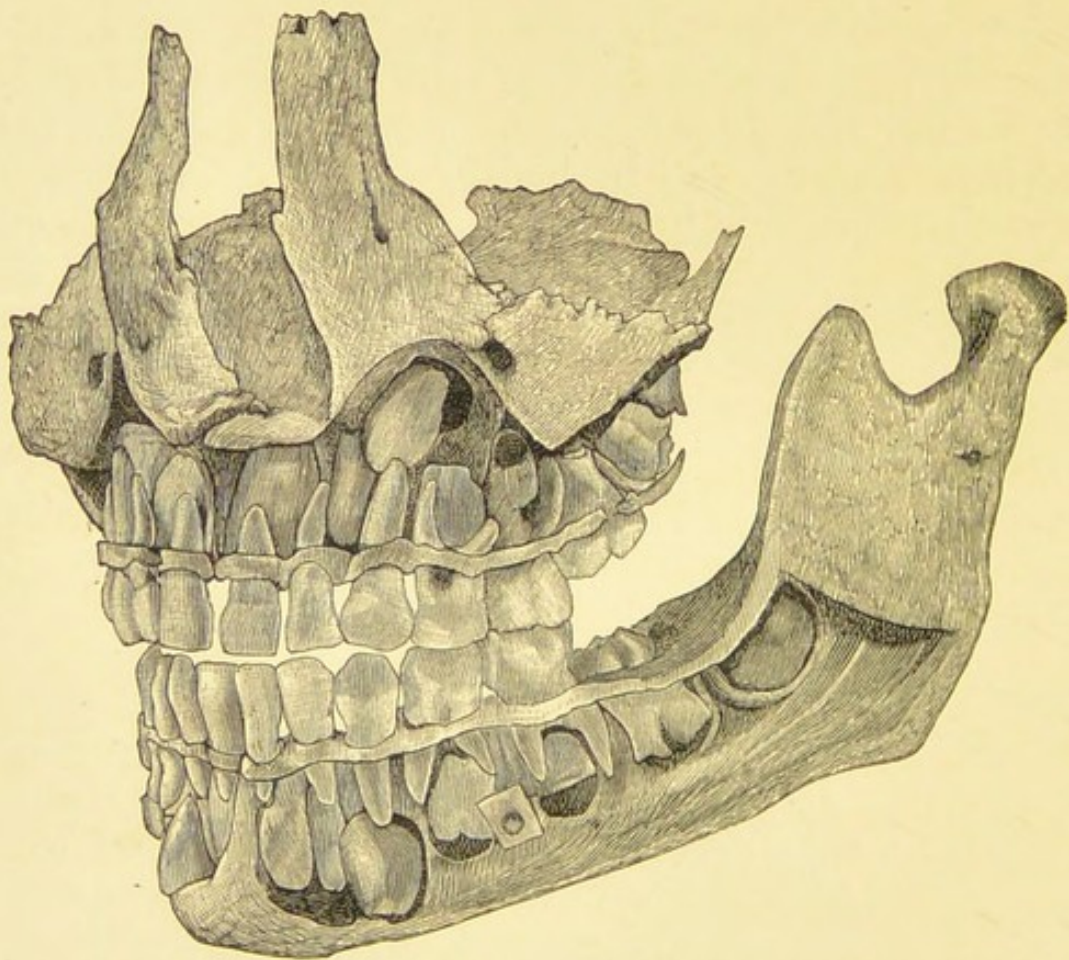


FIG. 77. From a skull aged about six years. Showing relation of the permanent to the temporary teeth.

That the development of the jaws may be arrested has been alluded to, and as the teeth in the majority of cases are normal in size, this will naturally lead to a crowded condition. It will easily be understood how this can be caused if a skull is examined about

the age of six. It will be found that the teeth are of their normal size, and the anterior ones are arranged in a crowded condition; any cause arresting the development of the maxilla at this age must of necessity lead to irregularity.

Unusual development in size of the teeth is not so frequently met with as the foregoing, and naturally leads to displacement by the space not being adequate. When the irregularity is due to the excessive development in the number of the teeth, the supernumerary may be either normal or abnormal in character, one or more being present. This condition is shown in fig. 20.

The eruption of the wisdom teeth is certainly an obscure cause of irregularity of the anterior teeth, but it is nevertheless important that it should be recognised. The eruption of these teeth causes pressure of all the teeth anterior to them, the effect being most marked upon the centrals and canines. The eruption of a lower wisdom tooth may lead to crowding of the lower teeth, and indirectly to irregularity of the maxilla. In a case under notice of one of the authors, the eruption of the lower wisdom tooth caused slight protrusion of the lower canine, which in its turn led to protrusion of the lateral incisor in the maxilla. In the majority of cases arising from this source the progress of the irregularity is very gradual, and in the case mentioned the cause was not recognised in time to remedy it.

The *treatment* when the crowding is due to excessive development in number of the teeth or eruption of the wisdom teeth is to remove the cause of the irregularity. In the former case, after removing the supernumerary teeth, it will probably be necessary to regulate the teeth by mechanical measures; while in the latter extraction of the wisdom teeth is generally sufficient, and should this not be so, mechanical means must then be resorted to. When due to too early extraction of the temporary teeth, arrest in development of the maxilla or excessive development of the teeth, the treatment resolves itself into one of either extraction, expansion, or a combination of the two. In cases where the jaws are markedly small, expansion is contra-indicated, and the case can only be treated by judicious extraction, followed, when

necessary, by the use of regulation plates. The same remarks apply to those cases of excessive development of teeth, for it is undesirable to endeavour to expand the arch, as the result would probably be unsightly. In treating cases of irregularity produced by the too early extraction of the temporary teeth, expansion is sometimes of value, but the larger proportion of cases are better treated by extraction. Which method should be adopted can only be arrived at after careful consideration of the case in all its bearings. Suitable cases for expansion are those where the arch is not already too large for the contour of the face, when the crowding is small in amount, and the teeth are strong and free from caries. The plate to be used for this operation is given in fig. 56.

In considering which tooth to extract, the relation of the upper to the lower, and also of contiguous teeth to each other, must be carefully considered. In very rare cases where one front

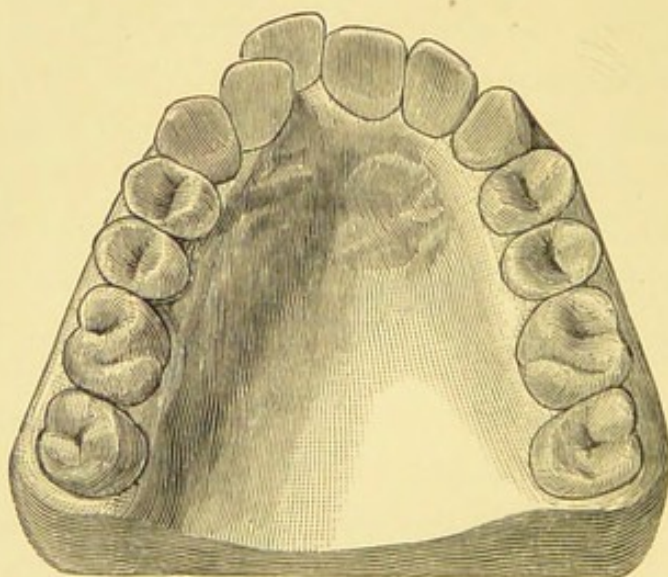


FIG. 78.

tooth, as shown in fig. 78, is irregular, and the patient unable to devote the necessary time to mechanical treatment, the tooth may be removed.

The *laterals* should be removed in those cases when the canine presents immediately above them or the root of the canine is

directed towards the median line, or when the laterals are placed much posterior to the arch (fig. 79) or are decayed. In the

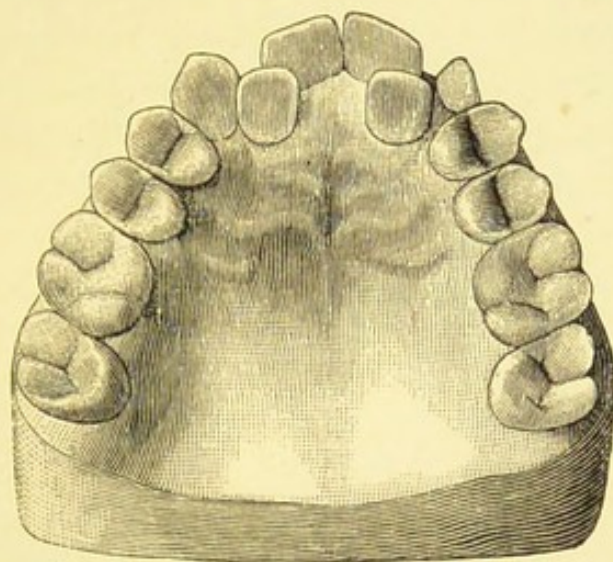


FIG. 79.

majority of cases a tooth posterior to the canine should be removed, and which tooth must depend upon existing conditions. This has already been discussed on page 51. When the first bicuspid has been removed the irregularity will generally correct itself without mechanical assistance, and it is often desirable, before resorting to such aid, to wait to see if nature will correct the deformity.

When it is decided that the removal of the molars is the better course, this should not be carried out until after the eruption of the second molars; because, if removed too early, those teeth will erupt into the position vacated by the first molar, and so prevent the occurrence of the space which was intended to be created. But at all times the second molars have a tendency to move forwards; and to overcome this and allow the teeth to travel back, Mr. Alfred Woodhouse has suggested the following method:—A vulcanite plate is made with half round wires to grip the second molars, and with the front portion of the plate fitting tightly against the four incisors, cutting the plate away freely in

the region of the canine and bicuspid (fig. 80). This plate forms a kind of splint, preventing the molar travelling forward and

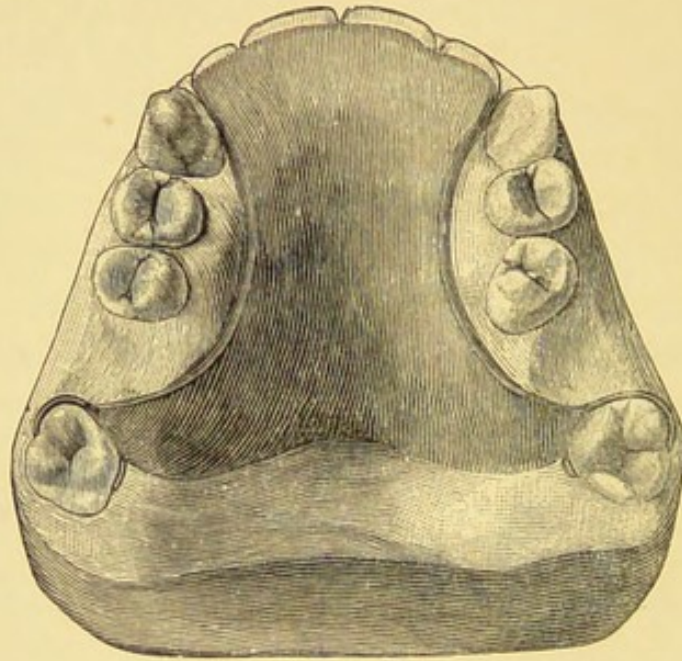


FIG. 80.

allowing the canine and bicuspids to travel backward, the cases generally regulating themselves without further mechanical aid.

Crowding of the anterior lower teeth is not so important from an æsthetic point of view as is the case in the upper. The most effective method of treating these cases when the crowding is small in amount is to remove an incisor, selecting as a rule the one displaced or most prominent; but if no special reason is evident for extracting a particular tooth, it is best to remove a central, for the reason that the symmetry of the mouth is to a certain extent maintained. The pressure from behind causes the space to be obliterated, quickly producing an excellent result. When more room is required it is often necessary to remove a back tooth on either side.

In all cases requiring extraction for crowding, as a rule it is desirable only to extract the deciduous tooth corresponding to the erupting permanent one. For instance, in those cases where the two lower permanent incisors have erupted within the arch, only

their two temporary predecessors should be extracted, and notwithstanding that they appear crowded the temporary lateral incisors should not be extracted to make room until their successors are ready to erupt, for the growth of the anterior portion of the jaw seems to depend upon the presence of the teeth, and moreover the temporary canine moves forward and so only aggravates the crowded condition. When irregularity of the lower front teeth is imminent from either excessive development of the teeth or arrest in development of the bone, it is better to wait till a later period and relieve the condition by the methods advocated above.

(3) Contracted Arch.

By contracted arch is generally understood that condition in which the bicuspid and molars of one side approximate abnormally those of the other. There are three varieties—

- (1) The **U**-shaped (fig. 81).
- (2) The **V**-shaped (fig. 82).
- (3) The saddle-shaped (fig. 83).

The exact *causes of this condition* are somewhat difficult to account for, and have not yet been worked out. In some cases it is hereditary, while in others it is found that the patients are of a low form, both mentally and physically. It is easy to see how the physical condition can produce them, but with the mental it is not so clear. Many cases can be accounted for by crowding; practically this is so in the case of the saddle-shaped arch, and, like so many irregularities, is probably in a great measure due to too early extraction of the temporary molars.

In the *U-shaped arch* the anterior teeth form a sharper curve than usual, the arch being generally a little prominent but regular. From the canine backwards the teeth on either side preserve a certain degree of parallelism. The teeth are not irregular, and appear to be embedded in the alveolus in the normal direction, and it would appear that the jaw itself, and not only the alveolus, is abnormally narrow. Sometimes the vault of the arch is high;

this is probably more apparent than real. Patients with this shaped arch have generally long narrow faces, the features being small and delicate and the head of the dolichocephalic variety.

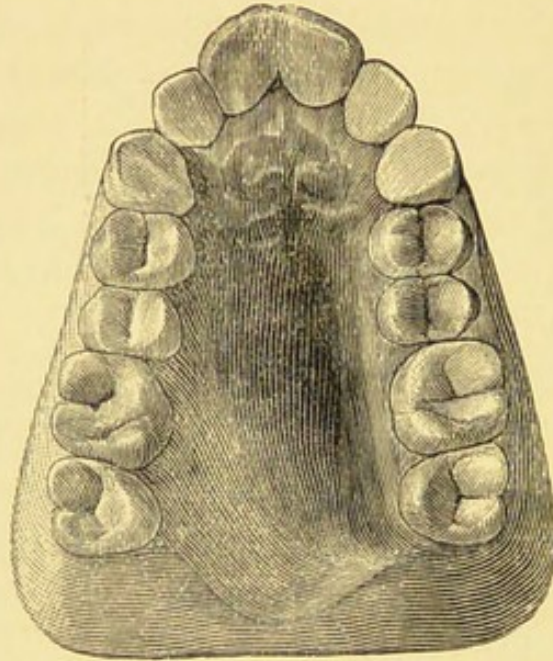


FIG. 81. U-shaped arch.

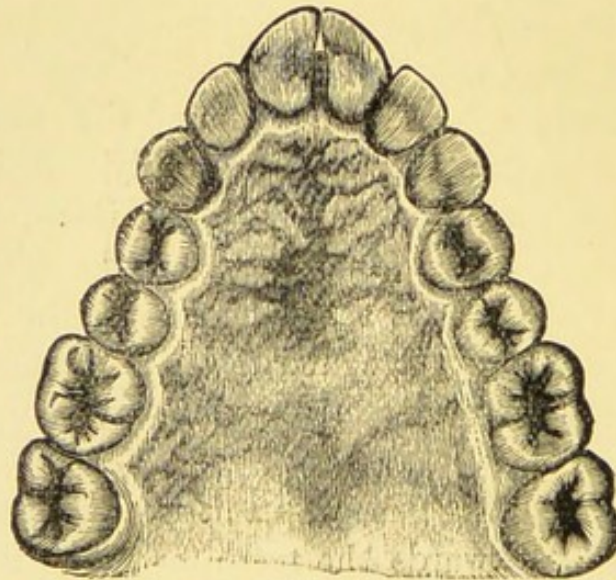


FIG. 82. V-shaped arch. (Kingsley.)

Treatment is not of much utility, but in some cases, when the arch of the lower teeth is larger than that of the upper,

modified expansion may improve matters slightly; but the majority of cases are better left alone.

The V-shaped arch is the name given to that condition where the mesial surface of the two centrals meet at an acute angle and the laterals and teeth behind diverge in straight lines, the anterior part of the arch thus losing its characteristic elliptical shape. The front teeth are generally prominent and the vault of the arch generally higher than usual, being of a Gothic rather than Norman shape.

The treatment of this variety, like the first, depends greatly upon the amount of irregularity present. In those instances where the irregularity is very slight the canines, bicuspid, and first molars may be slightly expanded and the pressure applied to the front teeth to make them flat, and by so doing make the arch more elliptical. In the very large majority of cases expansion is undesirable, but either the laterals or first bicuspid can be extracted, and so the appearance much improved.

The saddle-shaped arch is that irregularity in which the contraction of the arch takes place, principally in the bicuspid region, in well marked cases the molars being placed in straight divergent lines. The front teeth, as a rule, are fairly regular and generally protrude. In the majority of cases the body of the bone is not involved, the irregularity being confined to the alveolar border. Fig. 83 represents a typical form of this shaped arch. Many variations, however, from this are met with. For instance, it may be unilateral, it may be in combination with a V-shaped arch, or may be so modified as to form only a slight irregularity of the bicuspid. This, like the V-shaped arch, may in some cases be due to constitutional causes, and it is often found associated with chronic enlargement of the tonsils and adenoid growths in the naso-pharynx, and by some authors this condition is said to produce it; but it seems probable, as before stated, that the constitutional cause which gives rise to the adenoid growths leads to arrest of development through defective nutrition of the jaw, so causing a crowded condition. In a large number of cases this irregularity is caused by the position

taken by the first permanent molar. This position is modified according as to whether one or both temporary molars have been removed at an early period. When only the first tempor-

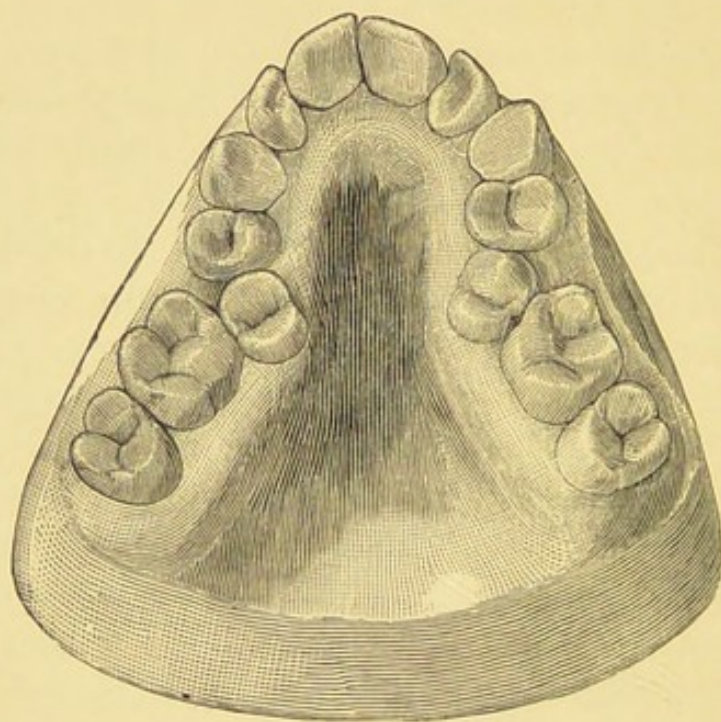


FIG. 83. Saddle-shaped arch.

ary molar has been removed the irregularity is correspondingly slight, but the removal of the second causes it to be much more pronounced, because in the latter case the first permanent molar has greater facility for erupting in a more anterior position.

Teeth in children of feeble type often have to be removed at an early date through premature decay. In this way may be accounted for the large number of cases of this shaped arch met with in patients of this class.

Treatment in these cases generally consists in removal of either the first or second bicuspid combined with slight expansion.

Any of our readers who may be particularly interested in this subject cannot do better than read the article on "Contracted Arches" by Talbot in his work upon *Irregularities of the Teeth*.

(4) **Anterior Protrusion of the Upper Front Teeth.**

By *anterior protrusion* is meant that deformity of the teeth characterised by an abnormal projection of the upper front teeth in such a way that when occluded the upper lip frequently fails to cover them and the lower lip passes behind them. It is an irregularity which in appearance is extremely unsightly and difficult to treat.

This condition is often hereditary, and in such cases the body of the maxilla itself may be involved or only the alveolus. It may arise from hypertrophy of the upper maxilla, especially the anterior portion, or from arrest in development of the lower jaw. It may be caused, as above said, by such habits as thumb, tongue, lip, or even toe sucking—a case of the last came under the care of Mr. F. Ewbank. Undue persistence of the deciduous teeth may act as a cause by allowing the permanent teeth to erupt in such a manner that the lower lip passes behind them, and the developing alveolus is naturally formed in an abnormally prominent position.

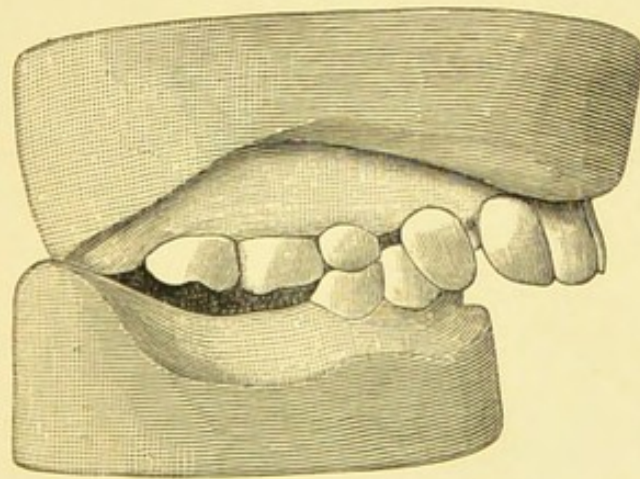


FIG. 84. A well-marked case of anterior protrusion.

A large number of cases are caused by the lower teeth biting firstly behind the cingulum of the upper teeth, and subsequently on the gum. This condition may be produced by a shortness of the teeth and alveolus in the molar region, and is said to be

combined with an arrest in development of the ascending ramus, or it may be due to early extraction of the first permanent molars or delayed eruption of these teeth. The cause may lie with lower incisors, which may erupt to an unusual height.

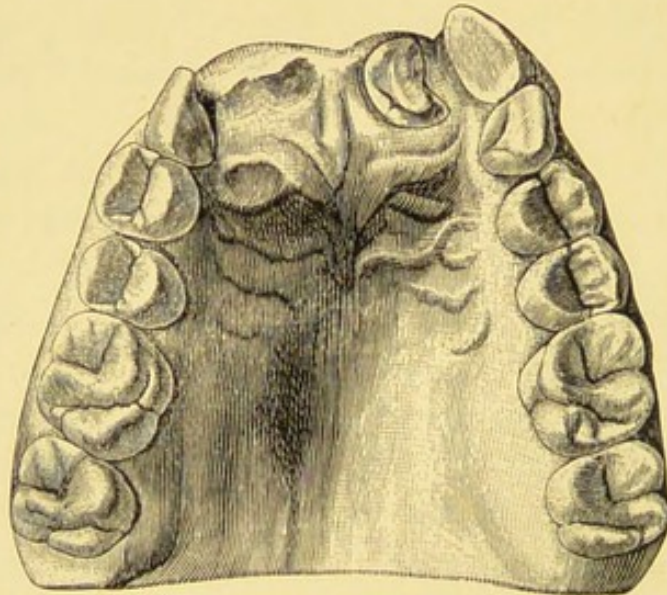


FIG. 85. A case of anterior protrusion due to supernumerary teeth. The teeth removed from this patient are represented in fig. 23.

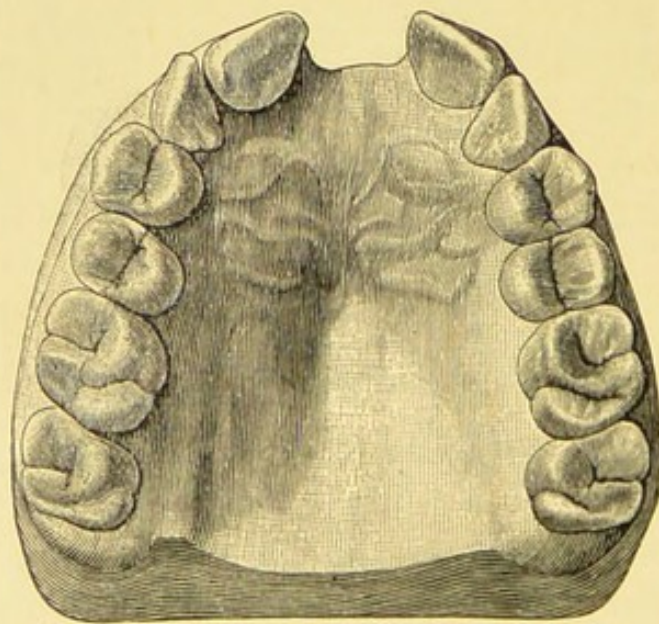


FIG. 86. The case shown in fig. 85, six months after the removal of the supernumerary teeth.

This is usually accompanied by apparently hypertrophy of the maxilla at this part.

Rarer causes of anterior protrusion are to be found in the presence of tumours, etc., in the upper incisor region. The foregoing conditions should be distinguished from such cases as badly-fitting dentures, which allow all the strain to be thrown upon the back of the front teeth.

Treatment will depend much upon the conditions of each case presented, and no definite lines can be laid down. One of the first points to determine is as to whether *the maxilla is involved* with the teeth, or whether the latter alone are affected. In the former treatment is inadvisable, for only harm is done by prolonged mechanical treatment which cannot result satisfactorily. Many cases of anterior protrusion show a tendency to improve with the advance of the patient to adult life, and the improvement in appearance thus produced is assisted by the growth of the facial bones and muscles.

Cases where the *alveolus is not involved*, and which admit of treatment, may be for practical purposes divided into those where the lower incisors impinge behind the cingula of the upper incisors, and those where such is not the case; a recognition of this difference will often save much subsequent disappointment, and also allow a much clearer idea to be formed of the probable result of treatment.

When *the lower incisors impinge behind the cingula of the upper teeth* or upon the gums, the first step necessary is to raise the bite. This can easily be done by making a plate to fit the upper, leaving it thick behind the incisor teeth, so that when *in situ* the lower incisors will meet it, leaving the bicuspids and molars free to elongate, and allowing the bite to open in front. When the teeth are raised sufficiently, the plate should be refitted in such a manner that the whole of the lower teeth antagonise with it, and should remain in position for two or three months in order that time may be given for the elongated teeth to become firmly fixed in their new position.

A tooth must then be extracted upon either side in both upper

and lower jaws, the first bicuspids when possible, and the canines and incisors retracted. For this purpose two plates will be necessary similar to figs. 57 and 45, the first being used for retracting the canines, the second for the incisors, both central and lateral. There are several other methods which can be employed. Some prefer a strip of rubber dam attached to the plate, maintaining that by this means the teeth can be readily drawn backwards, and that, if the rubber is brought below the tips of the teeth, it will have a tendency to curl round the edges, and so be prevented from slipping upon the gum and counteract the tendency of the teeth operated upon to elongate.

When the lower incisors are not the cause of the irregularity, and all the upper six front teeth are involved, it is only necessary to extract two teeth in the maxilla (one tooth on either side) and retract the teeth as just described.

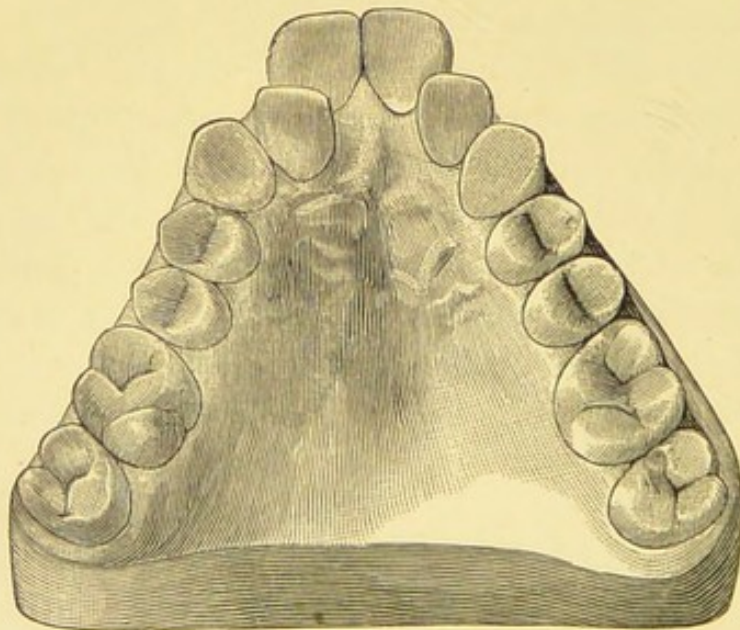


FIG. 87.

When the two centrals are involved in the irregularity, the treatment will depend upon whether or not there be room to retract them into position without involving the loss of teeth. When this is the case, the treatment consists in pulling back the misplaced teeth; but in those cases where the irregularity is the

result of crowding, and the lateral incisors forced into a position similar to fig. 87, the simplest and most effectual treatment is to remove the lateral incisors, the centrals frequently coming into position without mechanical aid. Any habit which may be found to be the cause of trouble should be broken, and this has been referred to on pages 15 and 68.

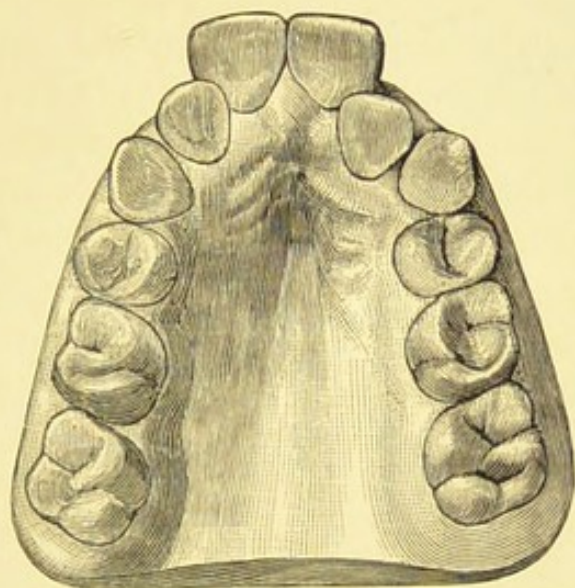


FIG. 88. A case of protrusion of central incisors. From a patient under the care of Mr. F. Ewbank.

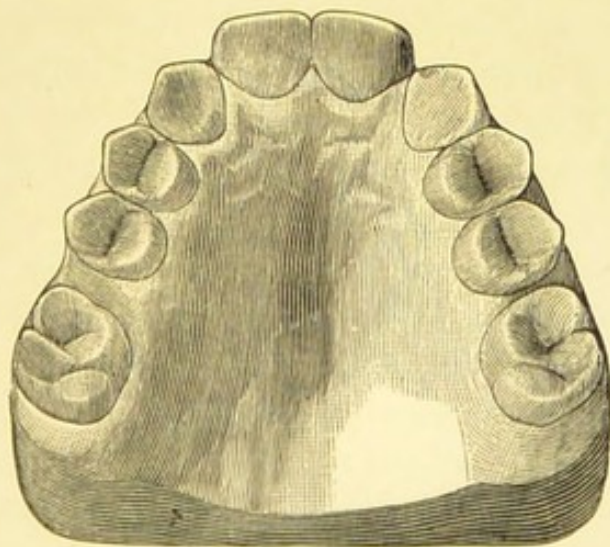


FIG. 89. The case shown in fig. 88 after treatment. The lateral incisors were removed, and also the first permanent molars (the latter for extensive caries).

In all cases of protruding teeth which have been treated mechanically it is necessary that retention plates should be worn for at least twelve months, as in this irregularity there is the greatest tendency to recurrence of the deformity.

(5) **Protrusion of the Lower Teeth**—"Underhung Bite."

In this condition the upper teeth, when the mouth is closed, pass behind the lower teeth instead of in front of them; and associated with this will generally be found a short upper lip and unduly prominent chin. It is a condition which is frequently inherited, running through a whole family, and this fact alone makes it extremely intractable to treatment. The *causes* may be found in an arrest or want of development of the whole maxilla, though more commonly the alveolar portion only is at fault. Undue development of the mandible, especially of the ascending ramus, is another frequent cause; the enlarged ascending ramus assumes an oblique direction, causing the horizontal ramus to be pushed forward, and naturally making the angle more obtuse than normal.

It is quite possible for the deformity to be acquired by the habit of constantly protruding the lower teeth. Cases where the protrusion is but slight may become much aggravated by early extraction of the back teeth. Such happened in the case shown in fig. 90. Lastly, protrusion of the lower teeth may be due to cicatrices. A good example of this is figured in Tomes' *Dental Surgery* on page 176.

The treatment of cases of underhung bite is usually difficult, and before undertaking it the *pros* and *cons* should be carefully weighed, in order to avoid unsatisfactory results. Cases where there is marked hereditary transmission, and which are at all severe, present but small chance of successful treatment. When the deformity is but slight, attempts at treatment can be made; and the earlier these are commenced, the greater is the chance of success. The treatment suggested on page 13 should then be carried out. In those cases which are brought under the

dentist's notice at a later age, after the eruption of the majority of the teeth, but little hope of success can be expected from the

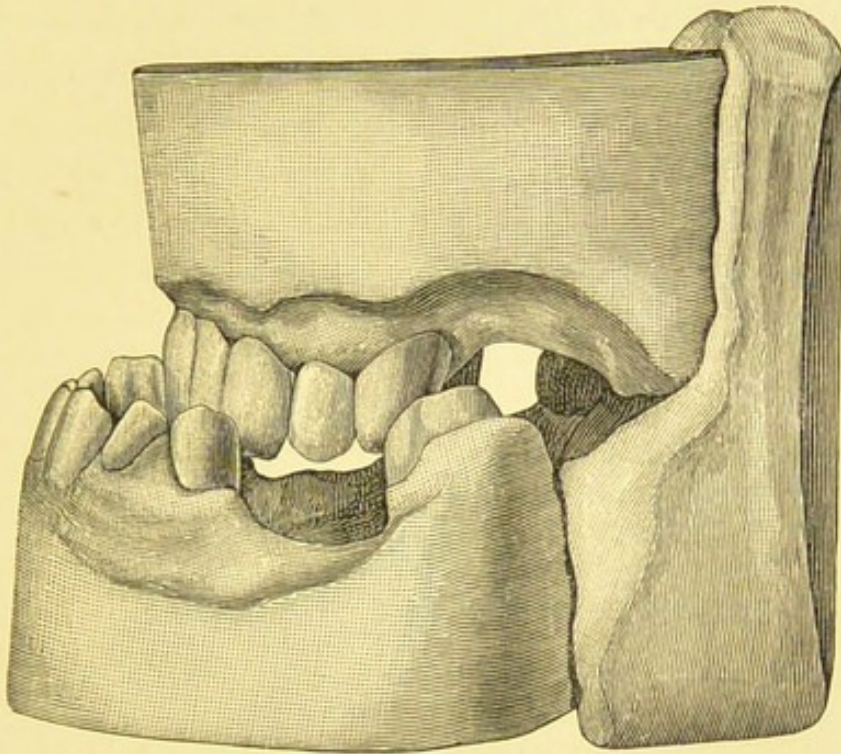


FIG. 90. Protrusion of the lower jaw.

skull and chin cap already referred to as dealing with irregularities of the temporary teeth ; but some cases can be considerably improved by enlarging the arch of the upper teeth, at the same time reducing that of the lower teeth. The upper can be enlarged with an ordinary expansion plate ; but in doing this, care must be taken not to make the teeth slope too much, and look unsightly. The reduction in the lower may be carried out by extracting either a bicuspid on either side, or by the extraction of an incisor.

In cases such as those shown in fig. 90, where the absence of the back teeth considerably increases the deformity, artificial teeth should be inserted.

"Edge to Edge Bite."

In this condition the upper and lower incisors meet edge to edge instead of overlapping. The causes producing this are practically the same as those leading to the preceding irregularity, it being a matter of degree. These cases usually need no treatment, as they neither cause deformity nor any practical inconvenience to the patient, the worst that can happen being that the incisors may be worn down at the cutting edge more quickly than normally, but this is so gradual as to be of little importance.

(6) Lack of Anterior Occlusion—"Open Bite."

This term is applied to that abnormal articulation of the teeth of the two jaws, in which the back ones only occlude when the mouth is closed, the remainder being separated by an interval. It is frequently met with in patients of strumous diathesis. *The causes producing this irregularity may be—*

(a) Thumb or finger sucking, the finger being bent and placed between the upper and lower teeth; this produces a different form of irregularity to the anterior protrusion produced by the end of the digit being placed behind the two upper front teeth.

(b) Arrest in development of the ascending ramus.

(c) From excessive eruption of the molars, which may be produced by constantly keeping the mouth open, for it is found that open bite is frequent in such patients.

(d) It may also arise in the treatment of irregularity by using a plate which does not cover the back teeth, and so allows them to elongate. The case shown in fig. 91 was produced in this way.

In the form produced by thumb sucking treatment is generally of no avail. If, however, the cause is recognised early enough, viz., when just commencing, the patient should be broken of any habit which may tend to increase the deformity; a skull and chin cap may be employed, made like that recommended when speaking of underhung cases, the difference being that

the pressure should be made in a more upward direction. In other cases it is possible to relieve the condition either by extraction of the occluding teeth, or by letting down the bite, or a combination of the two.

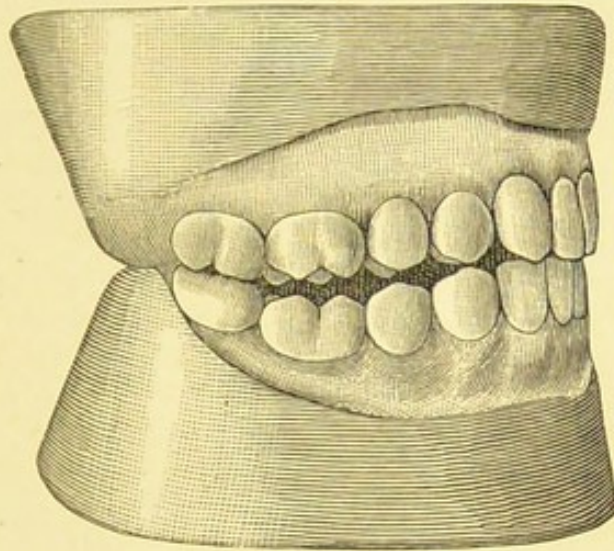


FIG. 91.

Figs. 92 and 93 represent a case of open bite which was treated in the following manner:—The remains of the first permanent molar teeth were extracted, and the bite cut down by means of small stump wheels (corundum) on the dental engine,

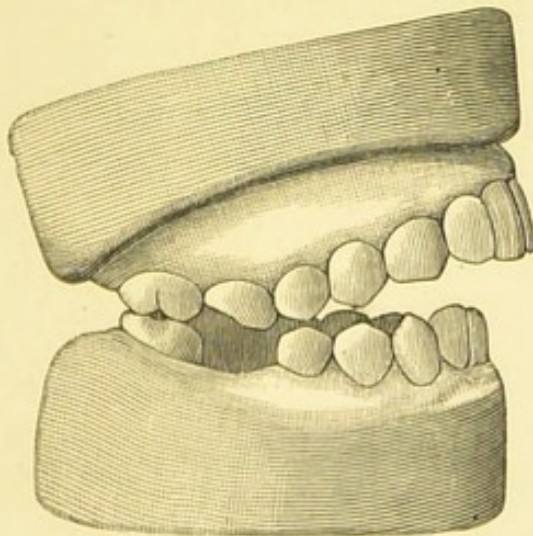


FIG. 92

the method adopted being exactly similar to that pursued in dealing with an artificial case. This operation occupied three sittings, and at the termination the surfaces of the teeth were

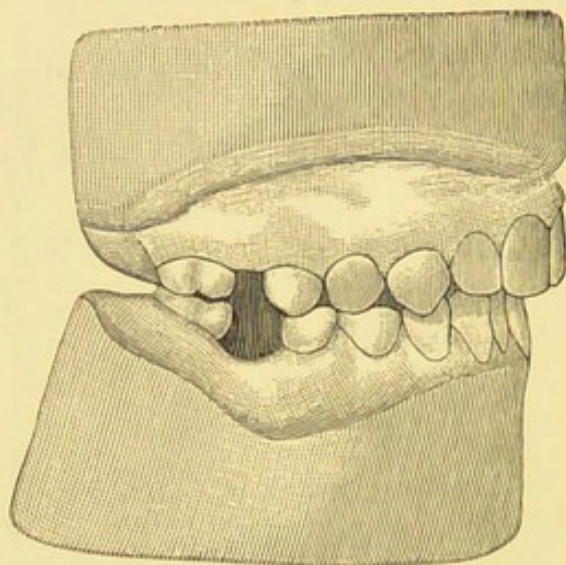


FIG. 93.

carefully polished with Arkansas stones and pumice on rubber discs. To allay the sensitiveness caused by grinding the teeth, the following was prescribed :—

R	Spr. ammon. aromat.	-	-	-	ʒj.
	Spr. vini rect.	-	-	-	ʒiij.
	Misce.	Ft. applicatio.			

To be mixed with equal parts of water and applied on cotton wool to the teeth frequently.

Should this mode of treatment be adopted the points to remember are—(a) Not to do too much at one sitting; (b) To thoroughly polish the surfaces of the teeth at the conclusion of the operation.

In all cases of doubt it is desirable to take models in duplicate and perform on them, using an articulator, the various methods that it is possible to adopt before deciding which to use.

The first permanent molar.

Physiologically it is the most useful tooth in the whole arch, since it presents the largest area of crown surface, it is

situate in a position where mastication is greatest, and is admirably adapted to bear the strain thus put upon it, inserted as it is into the malar process, the thickest portion of the maxilla. This tooth is of great importance in preserving the integrity of the arch, and, as a rule, should not be removed before the eruption of the second permanent molar. Its early removal, as pointed out in a preceding page, may lead to one of the varieties of anterior protrusion; its removal subsequent to the eruption of the second permanent molar may cause this latter tooth to "tilt forwards," and so lessen its value for mastication.

Pathologically, the first permanent molar is of interest, since it is more liable to caries than any other tooth, this being caused, probably, by its structure being weakened in its development at a period when nutrition in the child is often at fault. In the first permanent molar, we have these two great characteristics, the one militating against the other, *i.e.* its physiological utility in mastication and its pathological tendency to decay. And these two considerations must be carefully weighed before deciding upon treatment of this tooth. Probably the best method of treating the subject will be to assume the various cases that most frequently come before our notice and discuss them separately.

(1) *Given an overcrowded mouth and moderately sound first permanent molars.*—There can be no question that in these cases the bicuspid should be removed, and the molar, a tooth of far greater importance in mastication, be saved. When the molar has a small approximal cavity on its anterior surface the second bicuspid should be removed in preference to the first, as this will leave room for the easy insertion of a filling in the molar, and, the surface being accessible to the tongue, will be easily kept clean, and the filling rendered more durable.

Some practitioners make it a rule to remove the first permanent molars rather than the bicuspid on account of the greater liability to decay in the former. It should be remembered that the molar has withstood the secretions of the mouth for a much longer period than the bicuspid, and hence it is probably a stronger tooth. A first permanent molar that has

remained healthy until the age of twelve is less liable to approximal decay than the bicuspid.

(2) *Given an overcrowded mouth and carious first permanent molars.*—There can be little doubt that in these cases we should adopt radical treatment, and not only should such molars as are carious be extracted, but all four should be removed. Nature will usually overcome any crowding, and the gaps left will be gradually filled by the twelve-year old molars and second bicuspids.

(3) *Given a case with practically no overcrowding and carious six-year old molars.*—The amount of decay that has taken place, and the number of six-year old molars attacked by caries, must be taken into account. It is very unusual to find one of the six-year old molars carious and the other three sound, but if this be the case, conservative treatment should be adopted.

As a rule the wisdom teeth, from the fact that they are placed so far back in the dental arch, are of practically little use in mastication. Should, however, the treatment of extraction of the first permanent molar have been adopted, the third molars will come forward together with the second molars and take their normal functional use in the trituration of food.

Only in exceptional circumstances should the first permanent molars be extracted before the patient is from eleven and a half to twelve years old, and should the teeth be carious, they must be stopped, in order that they may last until the age specified. For stopping purposes, Sullivan's amalgam is certainly the best, as it appears to exert a hardening influence on the dentine. Should the pulp have to be extracted, great care must be taken with the drills, as the apical foramina are necessarily large.

When the patient has arrived at the age of twelve, the question arises, should the first permanent molars be extracted just as the second permanent molars are appearing through the gum, or should it be done when the latter are fully erupted? This must depend on circumstances. If extraction is to be performed on account of the unhealthiness of the first permanent molars, it should be done just before the eruption of the second molars, so that the latter may come well forward. When there

is much crowding, however, and a good space required, the operation must be deferred until the second molars are fully erupted.

(4) ABNORMALITIES IN FORM.

Among abnormal teeth are included all alterations in form, shape, or structure which have resulted from acquired, congenital, or hereditary causes. They will be considered under the following heads:—

- (1) Alterations produced by constitutional disturbance — (*a*) syphilis; (*b*) rachitis; (*c*) exanthemata; (*d*) disturbances of nutrition; (*e*) use of mercury; (*f*) gout.
- (2) Alteration produced by local disturbances.
- (3) Gemination.
- (4) Dilaceration.
- (5) Enamel nodules.
- (6) Abnormalities in the number of cusps.

(1) **Alterations Produced by Constitutional Disturbances.**

(*a*) *Syphilis*.—It is an established fact that congenital syphilis may leave as one of its marks a characteristic deformity of certain of the teeth. On a previous page we have referred to the effect that syphilis produces upon the eruption both of the temporary and permanent teeth, here we propose to deal with the anatomical condition of the deformity. The teeth generally affected are the permanent incisors, both upper and lower, at times the canines, and frequently the first molars. The incisors are small, peg-top-shaped teeth, standing apart so as to leave increased interspaces. These teeth are generally of a dusky earthy hue, which has been likened to “size,” though such discoloration does not always occur.

The distal margins of the centrals are generally turned outwards, while it is also noticed that the alveolar portion of the jaw in the incisor region is imperfectly developed. The teeth are

generally affected symmetrically; this is not always so, for at times one incisor is found perfectly formed while the other presents the typical syphilitic form.¹

In a healthy tooth when just erupted the cutting edge is seen to be surmounted by three little tubercles, separated by two shallow notches, and the tubercles being rapidly worn down by attrition the cutting edge soon appears quite straight. In the

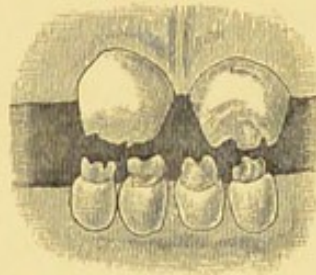


FIG. 94. Two upper and four lower incisors (permanent) of a girl, the subject of inherited syphilis, showing the appearance when the teeth have been recently cut. *Trans. Odontological Society*, vol. ii. (Old Series).

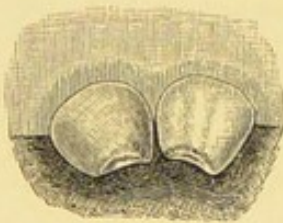


FIG. 95. Central incisors from a patient, the subject of inherited syphilis, the notches being less deep, but the narrowing more marked than in fig. 96. *Trans. Odontological Society*, vol. ii. (Old Series).

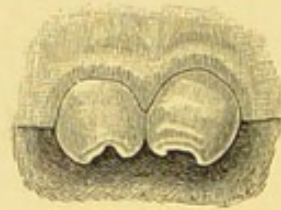


FIG. 96. Central incisors from a lad aged 15, the subject of inherited syphilis. *Trans. Odontological Society*, vol. ii. (Old Series).

syphilitic tooth these tubercles and notches are well marked, and the central tubercle is badly developed; the effect of attrition is to produce one central notch between the two outside tubercles. It is this central notch that is said to give to syphilitic teeth one of their characteristic appearances, but, as will be subsequently shown, it must not be solely relied upon in diagnosis, as it appears

¹ *Trans. Odontological Society*, vol. ix. p. 223. (New Series.)

to be produced in teeth where there is not the slightest taint of congenital syphilis. The large majority of syphilitic teeth are badly supplied with lime salts, and as a necessary consequence are rapidly attacked by caries or quickly worn away by mastication. The laterals are not always deformed, the centrals being considered by Mr. Jonathan Hutchinson as the "test teeth."

The deformity of the canines when existent shows itself by a circumferential notch occurring near the cutting edge or point of the crown.

The molars, like the centrals, are teeth smaller than normal, being dome-shaped, and the crown surface is of an irregular pattern, instead of having well developed cusps.

The *diagnosis of syphilitic teeth* is easy, though at times abnormal teeth are met with which somewhat simulate them. For instance, in patients who have suffered from rickets a distinct tapering notched tooth is sometimes seen, and in some cases of the so-called "honeycombed" teeth, where the deformity is confined to the edge, the central portion wears down more rapidly than at the side. The notch produced upon the teeth by the use of a clay pipe should not be mistaken for a syphilitic tooth, as it would be unilateral and altogether different in character. The diagnosis of congenital syphilis can also be confirmed by the presence of other lesions, such as scars radiating from the angles of the mouth, dusky-coloured skin, prominent forehead, broad depressed bridge of nose, and interstitial keratitis (a disease of the cornea).

Children who suffer from phagedænic ulceration of the mouth, syphilitic in origin, are generally free from the typical teeth. It is as well to remember that the diagnosis of congenital syphilis by no means rests upon the presence or absence of these teeth, for they are only met with in a small proportion of cases. Mr. Moon has afforded an explanation of the deformity. He believes that "the peculiar shape results from a stunted development of the first formed portion of dentine, in other words, a dwarfing of the cusps; and that the single central notch on their

cutting edge is due to a greater diminution in the size of the central than the lateral lobes."

That the incisors and molars should be affected is said to arise from the fact that at the time these teeth are in the course of formation, the effects of congenital syphilis would be most active. Syphilis is said only to affect the permanent dentition, but Mr. Oakley Coles has recorded a case of peg-shaped temporary teeth, which were very characteristic, occurring in a child, the mother of which had long been the subject of syphilis.¹

(b) *Rachitis*.—Rickets does not affect the teeth with anything like the constancy that congenital syphilis does, and it is difficult to say definitely whether the character of teeth occasionally seen in patients who have been the subjects of rachitis can be directly referred to its effects. Rickety patients frequently have sparse teeth slightly tapering, and this is seen not only in the incisor but also in the bicuspid and molar region. The tapering is at times well marked, and, in addition, there is a slight notch in the centre somewhat simulating that of syphilitic teeth, and unless care is taken the one may be mistaken for the other. Rickety teeth often have a bluish translucent appearance, the enamel being very smooth. The tapering form may be due to the same cause as the syphilitic, viz., arrest in development or calcification of the central denticle.

(c) *The exanthematous fevers*—(d) *The use of mercury*—(e) *Disturbances of nutrition*.—These constitute a most important group; their influence upon the teeth can frequently be traced, and as the deformity produced is apparently the same, it will be convenient to consider them together. The condition produced varies from a well-marked pitting to a slight grooving of the enamel. We will now consider the macroscopical and microscopical appearances produced by them.

Macroscopical appearances.—The enamel is found to be wanting in its normal glossy appearance, and instead of being smooth and even, is indented by small pits or grooves, the number of which varies. These pits may be arranged either in rows running

¹ *Trans. Odontological Society*, vol. ix. p. 244.

transversely across the tooth, or they may run more rarely in two rows in a vertical direction, situate in the places where the central denticle is supposed to unite with the two lateral; when the pits coalesce, an irregular groove is formed. Between the different rows of pits perfect enamel may be found, or the rows may be so numerous that the whole surface presents an extremely irregular appearance. The extent of tooth surface attacked will vary; in some cases only a portion will be involved, in others the complete crown. The teeth generally affected are the centrals, laterals, canines, and first permanent molars, to the

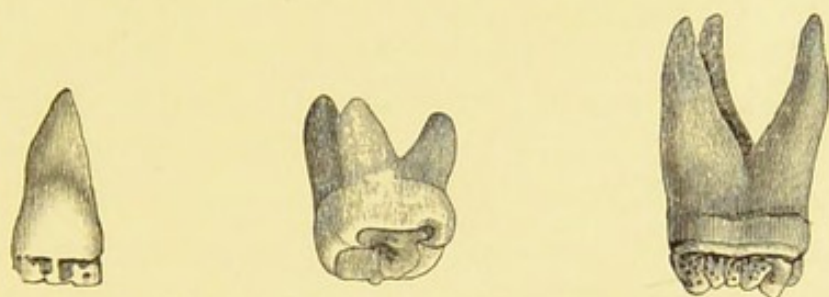


FIG. 97. Upper central and molars, showing honeycombed appearance.

extent of about half the crown surface of the central, a third of that of the laterals, the tip of the canine, and the greater part of the crown of the first molars. At other times these teeth are found quite free, while the bicuspid, with the second permanent molars, are pitted, and in rarer cases still, the whole of the crowns of the teeth will be implicated. In this last condition the incisors are generally thin and sharp, the bicuspid and molars



FIG. 98.

presenting also sharp cusps. Instead of rows of pits the abnormality may show itself in slight grooves on the surface of the enamel which otherwise appears normal (fig. 98).

Occasionally only the extreme tip of the incisors is attacked, and as the central portion apparently develops before the sides, it will be more affected, and so in process of mastication become worn down or broken off, thus giving rise to a well-marked notch; this, like that seen in rickets, must be carefully discriminated from that which is the result of syphilis.

Microscopical appearance.—The enamel will be found to be extremely thin in the position of the pits or grooves, and may, in some cases, be entirely absent. The striation of the enamel prisms is generally well marked, and the condition known as the “brown striæ of Retzius” also present. In severe cases, the enamel in parts appears as a homogeneous brown mass. The dentine is seen to contain a large number of interglobular spaces; and in those teeth where the cause has acted intermittently, these spaces will be found arranged in rows, taking an upward and inward direction, and corresponding to the pits or rows upon the enamel. (See fig. 99.)

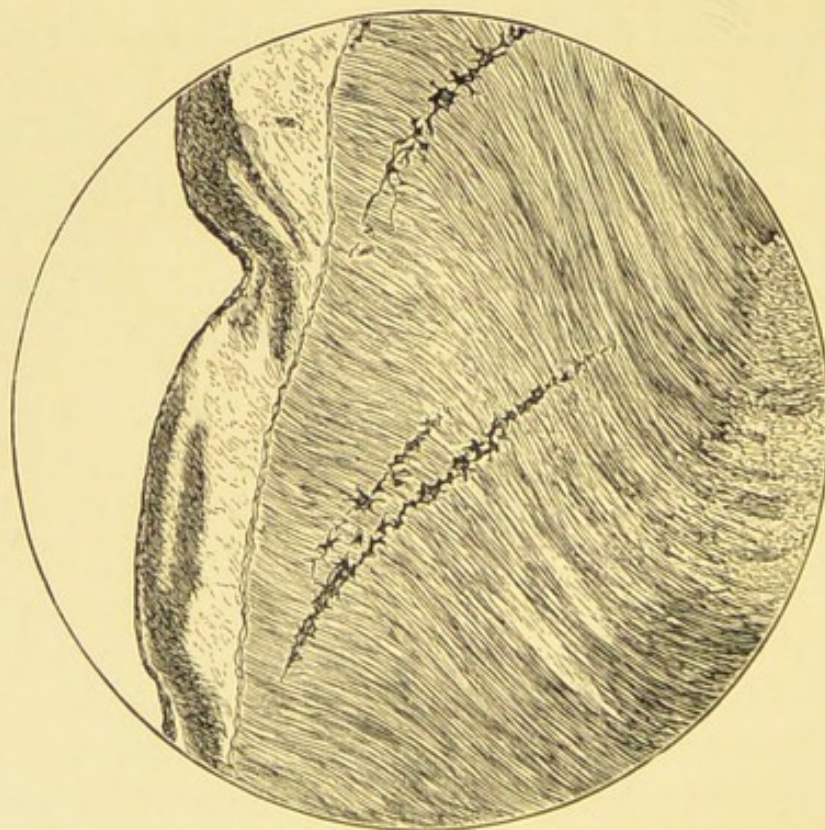


FIG. 99. Section of fig. 98 (b).

Having considered the nature of the deformity, we must discuss the probable causes that produce it. When attempting to associate the deformity with a special cause, it is necessary to see that the period when the deformed enamel was being calcified corresponded to that of the activity of the supposed cause.

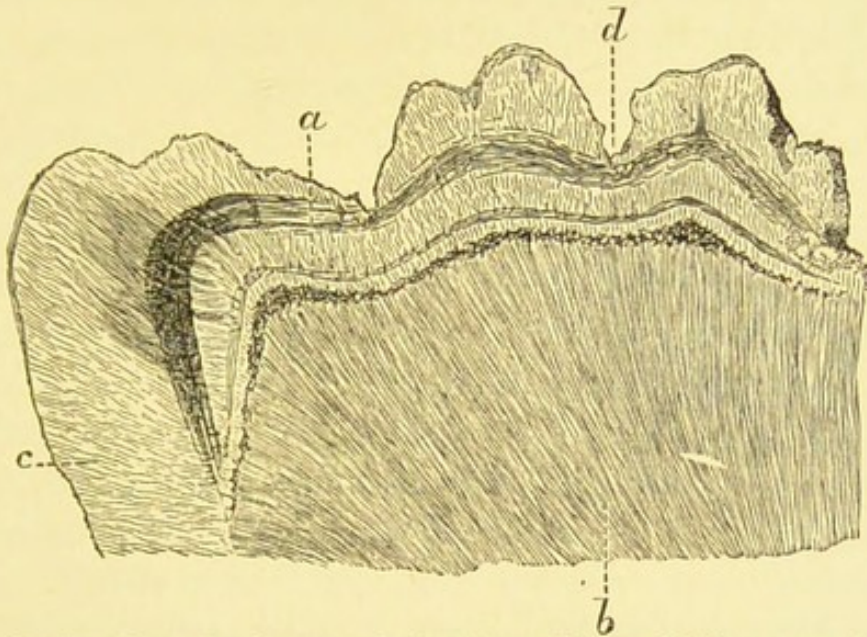


FIG. 100. Section through a honeycombed molar. (a) Interglobular spaces, (b) dentine (c) enamel, (d) situated in a pit upon the masticating surface.

The largest number of cases have the malformation on the apical half of the crowns of the central incisors, a third of the lateral, occasionally the tip of the canine, and the crown surface of the first molar. This points to a cause acting during the first two years of life, and has been said by Mr. Jonathan Hutchinson to be due to the use of mercury, causing a stomatitis; and he has gone so far as to designate these teeth "mercurial teeth," a term extremely misleading. In many patients having honeycombed teeth, there is frequently a history of administration of mercury for convulsions, etc., during teething; and in many who deny that mercury has been given it will be found that some form of teething powder has been exhibited, many of which contain mercury. On the other hand it should be remembered that many patients come under our notice to whom no teething powders have been administered, but the honeycombed teeth are

nevertheless present; and still further, cases have been seen where teething powders, including Stedman's, were freely administered during the process of teething, without apparent effect upon the structure of the teeth.

It has been asserted that the epileptiform convulsions associated with such cases during infancy are the cause of the deformity, while others state that it is the mercury given to cure the convulsions which produces the abnormality. These are not satisfactory explanations; and the following case is of interest as bearing upon the above. A patient, D. P., had three attacks of convulsions during teething, for which mercury was administered. The enamel of the teeth in this patient was deformed. The remaining members of the family had no convulsions, but nevertheless were given a numberless supply of teething powders, and yet the teeth were quite normal. This case shows that the convulsions and defective development were associated; however rather than looking upon one as the cause and the other as the effect, it seems more rational to regard both as effects from some common cause. From the history of many cases, it would appear that this defective dental development is due to mismanagement in the feeding of infants, as a large number of children with these teeth have been fed upon artificial foods.

Lamellar cataract is often associated with honeycombed teeth, and Mr. Hutchinson has ascribed the honeycombed teeth to the mercury given for the lamellar cataract; but, as with the convulsions, it seems more rational to believe both to be the result of a common cause. A possible origin may certainly be found in the exanthemata. It is well known that these eruptive fevers may lead to necrosis of the jaw; and from a study of cases, it is seen that the fevers leave an indelible mark upon the teeth, though it must be remembered that not every case of an exanthem occurring during infancy will affect the teeth. The facts which point to the exanthemata being the active cause in some cases are, briefly, that in otherwise healthy children, who have had one of the eruptive fevers during infancy, can be detected distinct structural defects; and that the period during which the

portion of tooth which is defective was calcifying is synchronous with the attack of the fever; and, again, there is the *primâ facie* probability that the eruptive fevers, which expend their force principally upon the skin and epithelial structures, should affect all epithelial structures, including the teeth.

Of the fevers, measles seems to be most prone to produce the deformity, next after that, scarlet fever. At first sight it would seem possible that each separate fever would produce characteristic results, but such does not seem to be the case, it being apparently impossible to tell which fever has been the cause. In support of this we may quote the following case, which occurred under the care of Mr. Bull:—A. D. had an attack of scarlet fever, followed at a short interval by an attack of measles, when two years old. The attacks were only slight, and little or no effect could be detected on the buccal surfaces of the incisors, but on the lingual surfaces of both the centrals and laterals appeared two slight rings, rather more than half way up. Both rings were precisely similar in appearance, and no doubt were the result of the two different attacks of fever.

(f) *Gout*.—Gout is said to produce characteristic teeth, but, if carefully examined, it will be found that this is only apparent and not real, the result being produced by early recession of the gums, combined with marked attrition upon the masticating surfaces, these two causes making the teeth appear long with squarish tops.

(2) **Local causes**.—Defects in the structure of teeth may in rare instances be produced by local causes, and we shall, in speaking of dilaceration, allude to the defective structure of the tissue in such cases. Abscess in connection with the temporary teeth may act as a cause, the tooth being affected in a manner similar to that produced by the exanthemata, etc.; in these cases single teeth are attacked, or only portions of them, the defective calcification being produced by alteration in the blood supply caused by the local disturbance. In one case met with, a patient had a single bicuspid affected, and distinctly remembered that the preceding temporary tooth was badly abscessed. In another instance, a

patient had a distinct line of pits half-way down the right lower central, and her mother remembered the child receiving a severe blow on the chin, injuring the temporary predecessors, leading to early loss of them.

(3) **Gemination.**—By gemination is understood the union of two or more teeth together by means of one or more of the dental tissues. It may arise during development, or subsequently as the result of pathological conditions in the alveolo-dental membrane. The former variety more frequently occurs in the upper or lower incisor region. Molars are sometimes geminated together, and union between lateral incisors and canines is occasionally seen, but very rarely between canine and bicuspid, bicuspid and bicuspid, first molar and bicuspid.

Supernumerary teeth are at times geminated with permanent ones. This is more frequently seen in the molar region, but it is not uncommon to find a central or lateral incisor united with a supernumerary lateral, and care should be taken before expressing an opinion as to the absence of a permanent tooth to see that it is not united with its neighbour; further, an abnormally large tooth should be differentiated from two geminated teeth. The union generally takes place throughout the whole length of the teeth, or it may be restricted to the crowns (figs. 101 and 102).



FIG. 101.



FIG. 102.

From specimens in the Museum of the Odontological Society.

The following figures show several forms of gemination. Fig. 103 shows two lower incisors united throughout their whole length, while fig. 104 a similar condition in the upper teeth; fig. 102, a

specimen in which the crowns only are united; figs. 105 and 106, one in which two molars are geminated; fig. 107, a molar and



FIG. 103.



FIG. 104. From a specimen in the possession of Mr. J. Smith Turner.



FIG. 105.



FIG. 106.



FIG. 107.



FIG. 108. A supernumerary tooth attached to the roots of an upper molar, the supernumerary tooth being inverted.

supernumerary tooth united; and fig. 109, a model showing symmetrical gemination of centrals with supernumerary laterals.

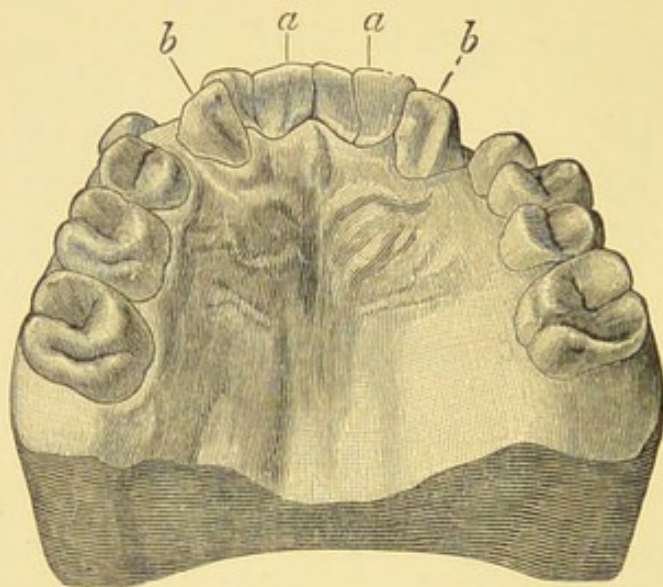


FIG. 109. (a) Geminated central and supernumerary lateral; (b) lateral.

The union, when the crowns alone are involved, is by continuity of both dentine and enamel, in which case there may be either a common or two pulp chambers. When the whole length of the tooth is involved, a similar condition exists, with the addition



FIG. 110. From a specimen lent by Mr. Somerling. This tooth was removed from the region of the second lower molar.

that there is also a continuity of cementum. It is also noticed that there is no increased amount of cementum. Union of this character must have been brought about by the close apposition (either partial or complete) and probable fusion of the germs of the developing teeth.

In gemination produced by disease, any adjacent teeth may become united, though it is more common at the back than the front of the mouth. The union takes place by simple cementum,

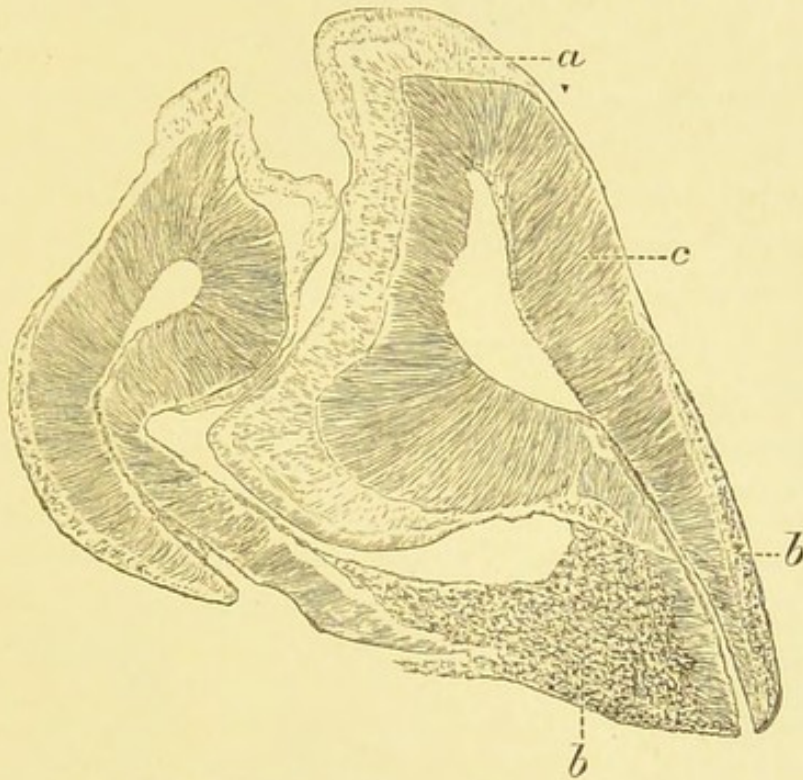


FIG. 111. Section of Fig. 110—(a) Enamel ; (b) cementum ; (c) dentine.

and is brought about by a chronic inflammation, which leads to organisation, and is really a cemento-plastic periodontitis, or



FIG. 112. From a specimen in the possession of Mr. J. Colyer.

condition similar to osteoplastic periostitis. Of cases coming under this heading, one which is unique is shown in fig. 112, in

which all three molars are united, the mass being removed for empyema of the antrum. The second upper molar is more commonly found united to the wisdom tooth in a manner similar to fig. 106, and is probably caused through want of space.

(4) **Dilaceration.**—In this condition we have a more or less distorted condition of crown or root, caused by injury to the tooth during the period of development. This condition when occurring in the root must be carefully distinguished from bending of the root from other causes. Dilaceration is more common in the front teeth, since they are more liable to injury; it is also met with in bicuspid, but rarely in molars. The injury may occur in the crown or root, the position depending upon the time of the receipt of the injury.



FIG. 113. From a specimen in the Museum of the Odontological Society.



FIG. 114. From the Museum of the Odontological Society. The dilaceration being in the region of the neck of the tooth.

In teeth dilacerated we often get a marked bulging at the neck. There is also marked mobility, and it is often possible to trace the



FIG. 115. Dilacerated upper central.



FIG. 116. Dilacerated upper first bicuspid.



FIG. 117. Dilacerated lower bicuspid.

root through the alveolar wall. Teeth which can be felt high up in the alveolar wall, which fail to erupt, may be suspected of

being dilacerated. If a section of these teeth be taken, it will be found at the point of dilaceration that the dentinal tubes are bent

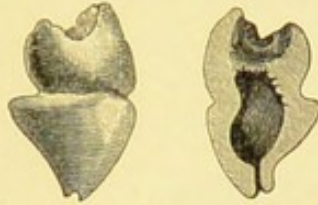


FIG. 118. Dilacerated upper first bicuspid, from specimen in possession of Mr. G. G. Champion.

and very much distorted, the relation of the dentine, enamel, and cementum being also altered.

(5) **Enamel nodules.**—Enamel nodules are those small excrescences, apparently consisting of enamel, occasionally met with upon the roots of tooth. They are generally found upon multiple-rooted teeth, being situated a little below the neck, and often

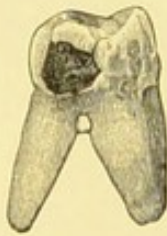


FIG. 119.



FIG. 120.

Enamel nodules. From specimens in the possession of Mr. J. Smith Turner.



FIG. 121. Upper molar with two enamel nodules. From a specimen belonging to Mr. L. Read.



FIG. 122.

at the junction of two roots. On section they are found to consist of a cone of dentine covered with a rather thick layer of

enamel. It will often be found that a sharp lamina of enamel connects the nodule with the crown of the tooth. Although generally seen upon multiple-rooted teeth, they are occasionally met with on teeth with single roots, Mr. Tomes, in his *Dental Surgery*,

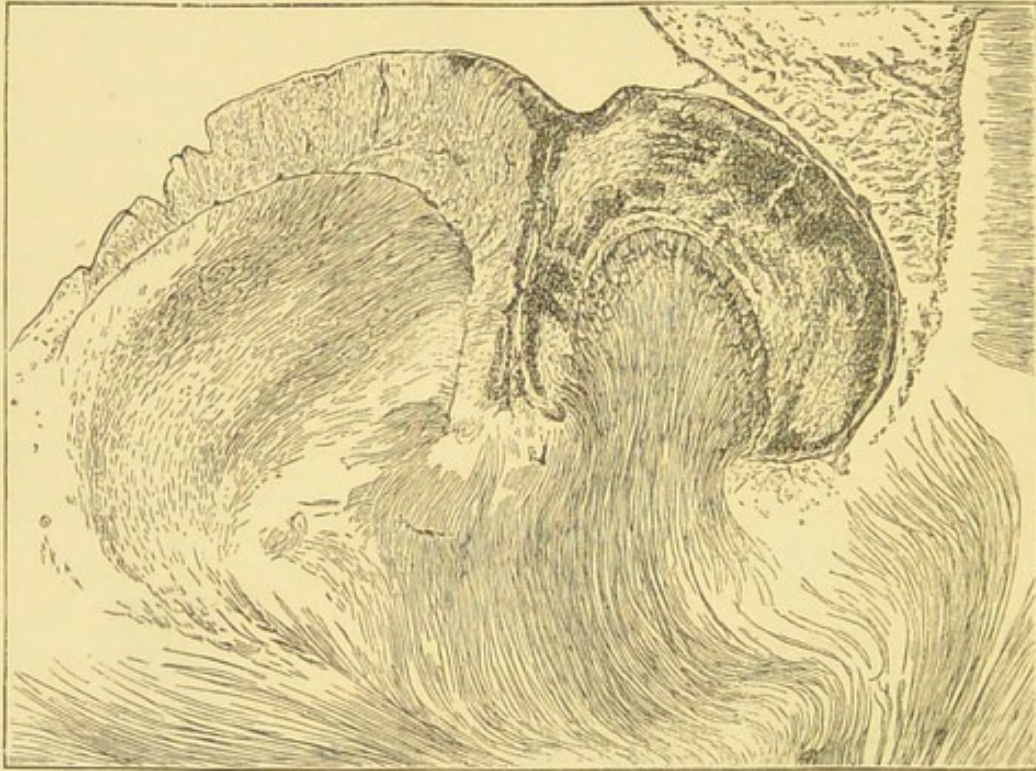


FIG. 123. Section through an enamel nodule upon an upper second molar.

figuring one on page 121, and Mr. Champion has in his possession a lower bicuspid with a large nodule just below the neck.



FIG. 124.

The specimen (fig. 122) represents a very large nodule between two palatine roots of an upper molar, and is in the possession of

Mr. L. Read, while that in fig. 124, from the Museum of the Odontological Society, shows a nodule situated at the apex of the root of an upper molar.



FIG. 125. Prolongation of enamel between the roots of a lower molar.



FIG. 126.

The transition from enamel nodules to supernumerary cusps or teeth is probably one of degree, and the same may be said of those prolongations of enamel which are seen running between the roots of multiple teeth, especially upper molars (fig. 126). Enamel nodules may be accounted for by dichotomy of the developmental germ, that is to say, a budding from the tissues concerned in the process of formation of the tooth; but Wedl, in accounting for them, says, "It is obvious that the nodules or ridges which are met with upon the molars are the result of localised continuations of the development of the enamel between the already developed basal portion of the roots, and are produced by the strip of the enamel organ which has persisted longer than the rest."

(6) **Abnormalities in the number of cusps, roots, direction of roots, etc.**—In dealing with this division of our subject, it is only possible to consider a few varieties such as are more commonly seen. The variations from the normal are almost endless, and may be brought about by crowding or hereditary causes. In addition to extra cusps and roots, the other alterations from the normal will be principally flexions and torsions of the root alone, or root and crown. The flexion of the root may take place at any part from the neck of the tooth to the apex, and may be single or multiple, and the twisting will vary considerably in amount. That condition termed axial torsion is usually confined to severe forms of

twisting, but all twists of even the slightest character should be included under this term.

The *upper central incisors* may be considerably flattened from

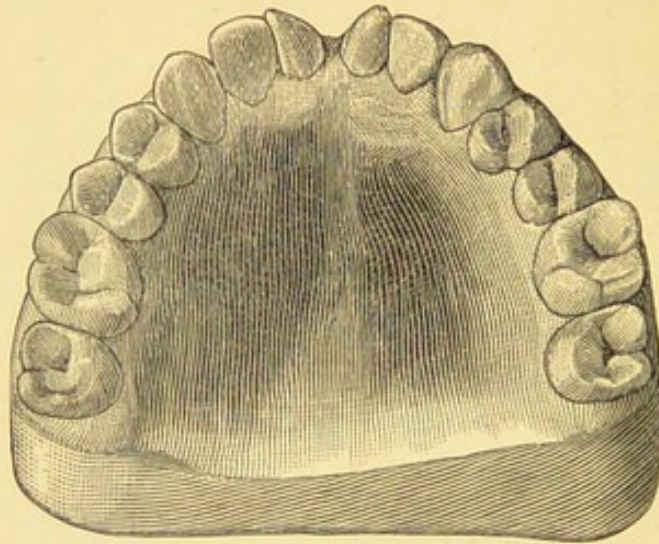


FIG. 127. Model showing alteration in shape of upper centrals. Students' Society of the Dental Hospital of London.

before backwards (fig. 128), or the crown may be so altered in shape (fig. 127) as to resemble a simple cone. The root is rarely

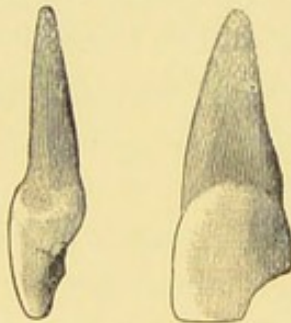


FIG. 128.



FIG. 129.

bifid, but is frequently twisted and flexed. A supplemental root springing from the labial surface is occasionally seen (fig. 129).

The *upper lateral incisor* is very variable in the shape of its crown, the mesial and distal angles being so rounded as to cause the tooth to resemble a canine, or it may be so diminished and

altered as to appear like a conical supernumerary tooth. The cingulum is sometimes well developed, and when such is the case



FIG. 130. Upper lateral showing flexion of root near apex.



FIG. 131.

caries is often found in that region. The root of the tooth may be considerably flattened and grooved laterally, flexions and twistings, as in the case of the central incisor, being met with, but a supplemental root springing from the lingual surface is rare.

The *upper canine* may reach $1\frac{3}{8}$ of an inch in length (Tomes). The twisting may be slight or considerable; very rarely a bifurcated apex may be present, or the development of the cingulum be so marked as to simulate a bicuspid.

The *upper first bicuspid* will occasionally present an additional



FIG. 132. Two rooted upper first bicuspid.



FIG. 133.



FIG. 134. Three rooted upper first bicuspid.



FIG. 135.

cuspid (fig. 131). These teeth often have two and sometimes three roots, and in the latter case the roots are arranged on the same plan as in the upper molar. The second upper bicuspid presents abnormalities similar to the first, though less commonly.

The *first upper molar*, in addition to extra cusps, may also

present peculiarities of its roots. The palatine root may unite with one or other of the buccal by a web-like layer of cementum; the two buccal roots may be joined together throughout their entire length, or they may be curved and approximate one



FIG. 136. Upper first molar, the posterior buccal and palatine roots being united by cementum.



FIG. 137. Upper first molar, showing all three roots united by cementum.



FIG. 138. Upper first molars, with supernumerary roots arising between the anterior buccal and palatine roots.



FIG. 139.



FIG. 140. Upper first molar, showing bifurcation of the palatine root.



FIG. 141. Abnormal shaped upper second molars.



FIG. 142.

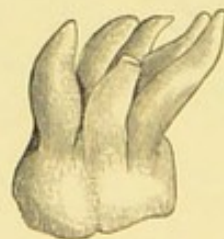


FIG. 143. Upper molar with six roots. (*Cosmos*, Jan. 1892, p. 81.)

another to such an extent as to embrace the septum, so that the tooth cannot be removed without fracturing this portion of bone. Extra roots usually arise between the anterior buccal and

palatine. This latter root may also be grooved or even bifurcated throughout its entire length (fig. 140). Under such conditions a little tongue of enamel is often seen to be prolonged down to the point of bifurcation. The roots may be very divergent, and torsions and flexions occur in great variety. The *upper second molar* may present abnormalities similar to the first. Two roots only are rarely met with, but more frequently the abnormality consists in a fusion of the roots, and the condition known as the "oblique



FIG. 144. Normal left upper first molar.



FIG. 145. Oblique rooted left upper first molar.



FIG. 146. Normal right upper second molar.



FIG. 147. Oblique rooted upper right second molar.

root" is seen more frequently in this than the first.¹ In this condition the post-buccal root is situated in a plane much internal



FIG. 148. Abnormal upper third molar.



FIG. 149. Upper third molar, showing a peculiar flexion of the buccal roots.

to the anterior buccal, causing a deformity, which renders extraction with ordinary upper molar forceps troublesome. The

¹ The term "oblique root" was suggested by Mr. Pearsall in a paper read before the annual meeting of the British Dental Association, 1891.

third upper molar presents an immense variety in shape. The roots may be all fused together, and in one specimen in the Museum of the Odontological Society the apex is cup-shaped, with numerous holes for the vessels of the pulp to enter. Like the preceding, the roots may be increased in number, and also flexed or twisted.

The *lower incisors* seldom present any abnormality, with the



FIG. 150. Two rooted lower canine.



FIG. 151. First lower molar with three roots.

exception that a supplemental root may spring from the approximal or lingual surface.

The *lower canines*, far more frequently than the upper, have two roots. The root may be bifurcated or a supplemental one be present.

The *lower bicuspid* may have two roots, and the inner cusp of this tooth is sometimes but feebly developed, simulating a canine.

The *first lower molar*, in addition to supplemental cusps, may have both roots united together. This is rare; more frequently



FIG. 152. First lower molar with supernumerary root.



FIG. 153. Four rooted first lower molar.

they are divergent or present a backward curvature. When three roots are present the anterior is usually the one bifurcated,

while in some cases the third root is a supernumerary one (fig. 152); when four, both anterior and posterior are subdivided. Five or even six roots are recorded, but such instances are rare; and



FIG. 154. Lower molar with five roots.

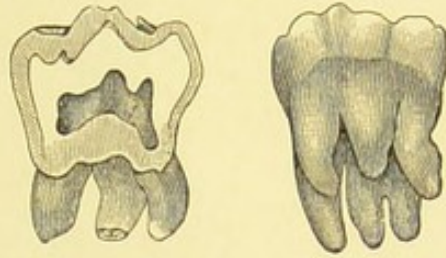


FIG. 155. Lower molar with six roots.

the example of these (figs. 154 and 155) are taken from Wedl's *Atlas of Dental Pathology*. The *second lower molar* presents abnormality similar to the first; fusion of the roots (fig. 156), however, is more commonly seen. The *third lower molar* may present an increased number of cusps, or the whole tooth may be reduced to



FIG. 156.



FIG. 157. Right lower third molar, showing peculiar abnormality of the posterior external cusp.



FIG. 158. Abnormal-shaped tooth from region of lower third molar. From specimen in the Museum of the Odontological Society.



FIG. 159.

a comparatively small size. The roots are often fused together and curved well backwards, and are at times grooved by the

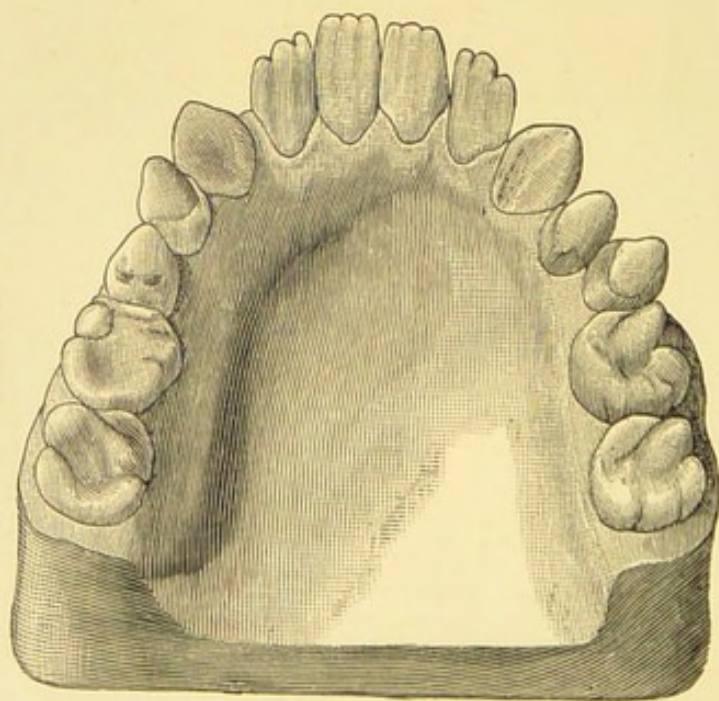
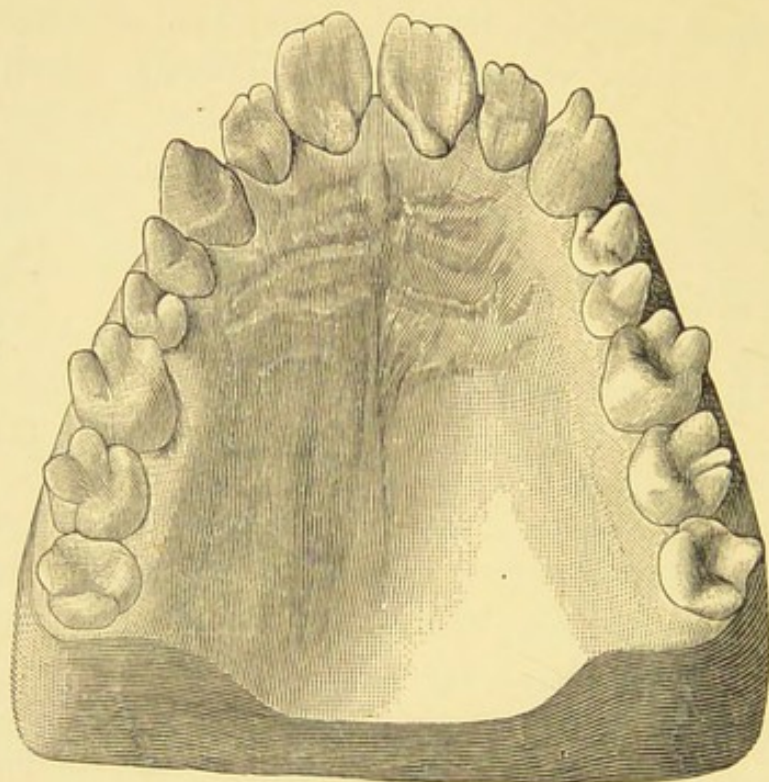


FIG. 160.

inferior dental nerve; and, in cases recorded, a foramen has existed for the passage of the nerve. In one variety met with the roots are fused together, while toward the apices each bifurcates, presenting four small roots (fig. 159).

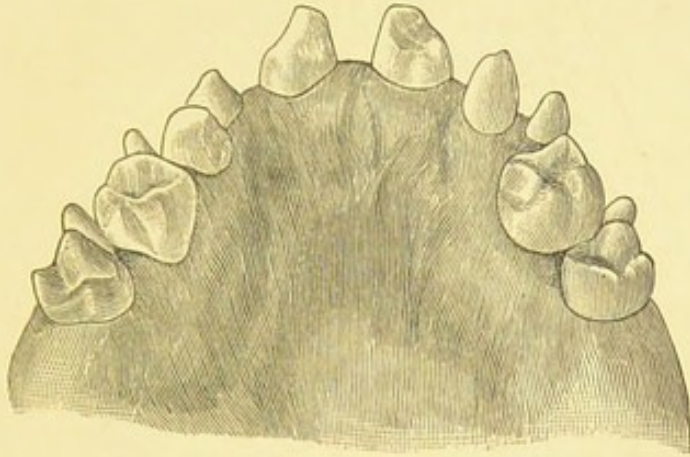


FIG. 161.

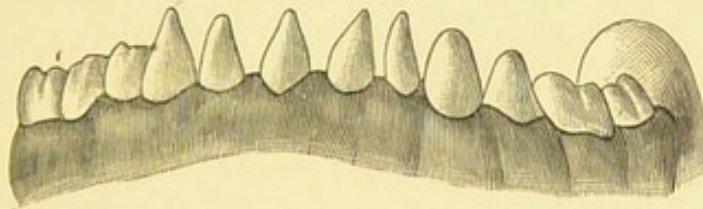


FIG. 162.

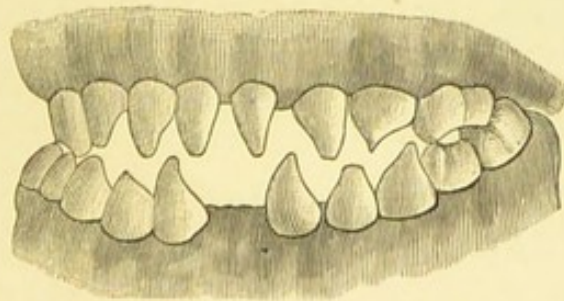


FIG. 163.

Deviations from the normal type, involving many of the teeth, have been from time to time recorded. In fig. 160 is shown

a case of this character which occurred in the practice of Mr. C. C. Robbins,¹ while those represented by figs. 161, 162, and 163 were recorded by the late Mr. H. Moon.²

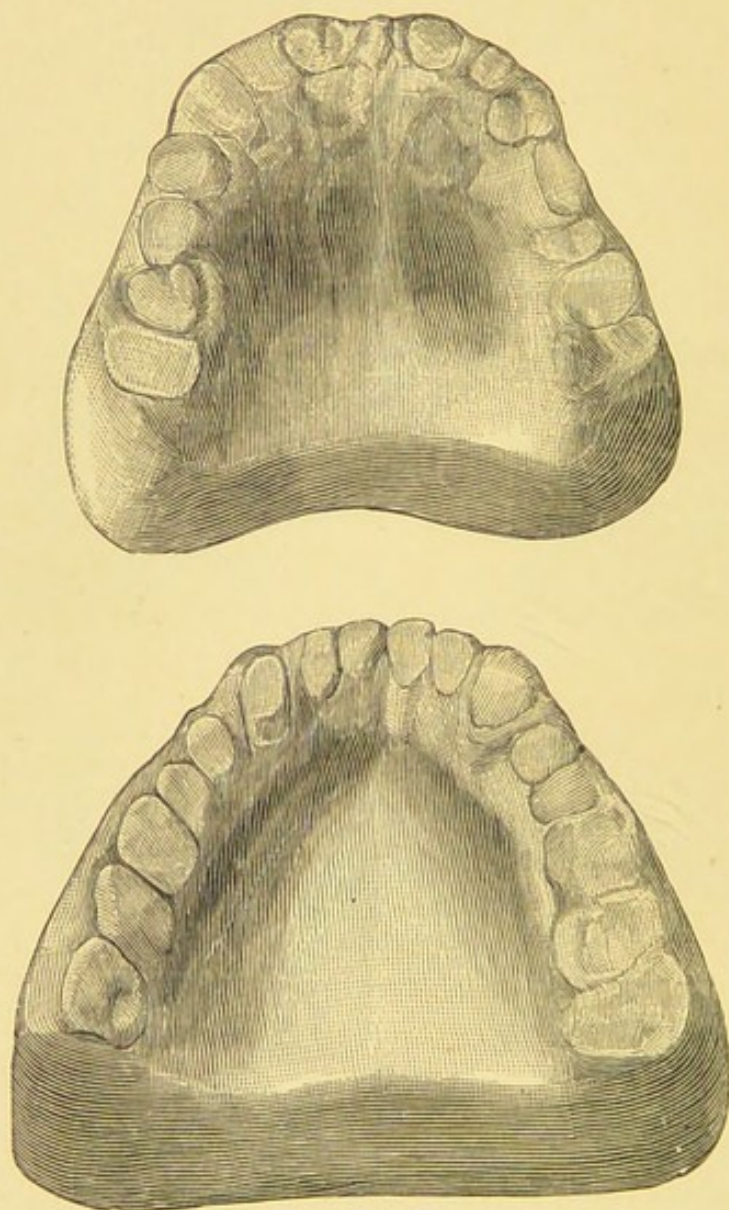


FIG. 164. Models showing defective dentition. From the Museum of the Students' Society Dental Hospital of London. A similar case to this is described in *The American System of Dental Surgery*, vol. iii. p. 415.

¹ *Transactions Odontological Society*, vol. xxiii., New Series, p. 80.

² *Transactions Odontological Society*, vol. ix., New Series, plate iii.

CHAPTER V.

INJURIES OF THE TEETH: CONCUSSION, DISLOCATION, AND FRACTURE.

CONCUSSION of the teeth may arise from direct or indirect violence. Examples of the former occur from blows from the fist, a cricket ball, etc.; while falls or blows upon the chin, jumping upon the heels instead of the toes, will be examples of the latter. The injury may give rise to slight or severe periodontitis, and this may be complicated with pulpitis, which may subsequently lead to death of the pulp. The pulp may be ruptured from its connection at the apical foramen at the time of injury, leading to periodontitis; but occasionally in these cases the pulp remains quiescent, and marked discoloration of the tooth substance supervenes, due to the colouring material of the blood passing into the dentinal tubes.

Most patients presenting themselves with this injury will be found suffering from periodontitis more or less severe. In cases where the pulp has not been ruptured at the apical foramen, or where the inflammation of the periosteum has not extended to the pulp, the tooth will be found sensitive to pressure, and will respond to thermal changes in the same way that a normal tooth will do. Should the inflammation have spread to the pulp the tooth will be found exquisitely sensitive both to pressure and to slight variations of temperature, the periosteal pain being dull is constant and restricted to the tooth; while that arising from the inflamed pulp sharp, shooting, and frequently of a

neuralgic character—being referred at times to other teeth and adjacent parts. When suppuration in the pulp occurs the tooth will no longer be sensitive to changes of temperature, but the periosteal inflammation will increase in severity, owing to the suppuration having spread to the periosteum, and the pain changes to a throbbing character.

It is of importance to diagnose whether or not the pulp is implicated, as the treatment in each case is different. The periosteum only being affected, local depletion either by means of the lancet or by the application of a leech will be found efficacious; in milder cases counter irritation, with Capsicum plasters, Lin. iodi., will be sufficient. When suppuration has taken place in the pulp chamber this must be drilled into, in that position which renders removal of the pulp easiest; the dead pulp must be removed and the canals filled.

Dislocation of the teeth.—By dislocation is understood the accidental displacement of a tooth from its normal position in its socket. *It results from causes similar to concussion*, though generally of a more severe nature, and an example is seen in teeth forced out of place by the “prop” used during the administration of anæsthetics. Dislocation may be partial or complete. In the former the tooth may be forced into or loosened in the socket. *The treatment of this accident, when the dislocation is partial*, is to replace the tooth, mould the broken alveolus round it, and apply counter-irritants over the gum. In all cases of dislocation some precaution should be taken to keep the tooth *in situ*, by ligatures of silk, wire, or by a small vulcanite splint. If the tooth is driven into the socket, it should be grasped with a fine bladed pair of forceps and carefully drawn down into place. When, however, a tooth is driven upwards towards the antrum, great care must be taken that it is not displaced into that cavity.

If the displacement is complete, the treatment will vary according to the age of the patient and the time at which he is seen subsequently to the accident. In young people, if seen directly after the accident (as, for example, when the tooth is displaced

in the operating room), the tooth should be at once replaced, as under these conditions union of the structures entering at the apex may take place; cases have been recorded exemplifying the truth of this statement. If the patient is an adult, or is seen some hours after the accident, the pulp of the injured tooth must be removed and the canals filled before it is replaced.

Fracture of teeth.—The front upper teeth are more frequently fractured than any of the others. The causes are generally direct or indirect violence, such as blows from cricket balls, the fist, kicks from horses, or at football, blows upon the chin, etc. Biting upon hard substances in food, such as shot in game, frequently causes this accident in the back teeth, especially when such are weakened by caries. Evolution of gas in the pulp chamber is also given as a cause. This accident varies considerably in degree. There may be—

- (1) Slight cracks or fissures involving the enamel only without loss of substance;
- (2) Various degrees of chipping of the enamel alone, or enamel and dentine, without exposure of the pulp;
- (3) Transverse fracture involving the pulp chamber (*a*) in the crown, (*b*) in the root;
- (4) Longitudinal fractures;
- (5) Oblique fractures.

The first group of cases do not require treatment. In the second, if the fracture involves only enamel, it will be necessary to smooth the rough edge or edges with corundum wheels and polish the surface. Should the dentine be exposed, it may be found hyper-sensitive, especially in young patients. There will also be hyper-æmia of the pulp, characterised by extreme sensitiveness to heat and cold, and pain upon pressure due to extension of the congestion to the periosteum around the apex. The treatment is to employ counter-irritants or local depletion, at the same time applying to the exposed dentine local applications, such as absolute alcohol, phosphoric acid, nitrate of silver, or chloride of zinc. The symptoms usually subside, and at a later period the tooth and its neighbour should be trimmed in such a way that the disfigure-

ment may be as little noticeable as possible. Should suppuration occur in the pulp from continued irritation, the pulp cavity must be opened and treated in the usual way.

Transverse fractures of the six front teeth, involving the pulp chambers, and situate in the crowns of the teeth, are accidents by no means uncommon. In patients under the age of eleven, the mouth being crowded, it is often advisable to remove the fractured tooth; the space will subsequently fill up and a fairly regular arch result. Each case must however be judged upon its own merits, and treated accordingly. In cases of fracture of one central, the treatment by extraction is most favourable when the lateral incisors are of large size. When the teeth are not crowded and the root is not perfectly formed it is necessary to remove it, for pivoting at a future date is impracticable, as the growth of the tooth will be arrested. When the accident occurs subsequently to the period at which the growth of the root is completed, the patient should be anæsthetised, the nerve extracted, and the root canal filled, and at about the eighteenth year the tooth pivoted. In a mouth with the front teeth crowded, it is in many cases preferable to remove the tooth, but this should not be done after the fourteenth year, as the space may not fill up, and the teeth slope in an awkward manner.

Transverse fracture of the root, and oblique fractures if high up, will be best treated by extraction, but if the fracture does not involve much of the root it can be treated upon the same principles as transverse fracture of the crown. When the fracture is near the apex of the root the accident may not be recognised, the patient only suffering from neuralgia, accompanied by slight looseness of the tooth. In all suspected cases crepitus should be carefully sought. In fractures running in a longitudinal direction the tooth should be extracted. Fractures of the back teeth occur only in adults; the treatment resolves itself into one of two courses. If the fracture is in such a position that the roots are involved, extraction must be resorted to; but in those cases in which the crown is alone injured, the root should be crowned. Union of fractured teeth may take place, and

several cases have been recorded. The union takes place in a similar manner to that in bone. In a case quoted by Wedl, and shown in his *Atlas of Pathology*, union is effected by means of the periosteum and root pulp.

Fractured roots are more likely to unite when the fracture is near the apex, because the fragments are kept in fairly accurate apposition by the socket of the teeth.

CHAPTER VI.

CARIES.

CARIES is by far the most prevalent disease of the human race, being found amongst all nations, but more particularly those races where civilisation is most advanced.

It has been the subject of much literature, and investigators in all ages have turned their attention to it, from Hippocrates (B.C. 406) to the present time, and amongst later workers must be mentioned the names of Tomes, Black, Milles, Underwood, and Miller, their investigations, and especially those of the last-named, having done much to elucidate the whole subject.

Caries of the teeth is not analogous to the same process occurring in bone or cartilage, since in the latter the changes are produced by internal or vital causes, while in the former by external causes.

The teeth are not all prone to caries to the same extent, and it is noticed that females are more liable to it than males, and that it is more frequent under the age of 25 and over 50 than between these ages.

From statistics, it appears that the first permanent lower molar is the tooth most prone to caries, and after it the first upper molar, then follows the second lower molar, the first upper bicuspid, the second upper bicuspid, and the second upper molar. The lower bicuspid is not so liable to decay as the uppers, and of the two bicuspid caries is more frequently seen in the second. The upper front teeth more frequently become carious

than the lower, the order of frequency being the lateral, central, and canine.

In considering this subject, chemical, physical, and microscopical aspects of the process will first be considered, and then the ætiology and treatment.

Phenomena—Macroscopical appearances.—*The naked eye appearances of caries* in enamel are best observed upon the approximal side of a molar or bicuspid. The earliest indication that caries is commencing is that the enamel loses its normal polish and translucency. Following this a whitish spot appears, which gradually becomes darker, according as the process is rapid or otherwise, the darker colour being found when the progress is slow, the whitish when rapid. As the enamel prisms become disorganised, they are mechanically washed away, so that a cavity is left which varies somewhat in form, being sometimes broad and shallow, with indistinguishable margins; at other times deep, with sharp rugged margins. The destruction advances until the dentine is reached. When the decay which has started on an approximal surface reaches the under surface of the enamel of the crown (as is frequently the case in bicuspids and molars), that portion which is being attacked appears bluish-white and translucent, especially in artificial light. This is produced by the decalcified tissue which has not been removed by the saliva. As the caries reaches the surface, the enamel appears whiter, and eventually becomes so thin that mastication fractures it, and the under surface is found to be of a soft cheesy consistence. This is termed by Miller *secondary enamel decay*.

When *the dentine* is reached a change takes place. This tissue becomes of a tough cartilaginous consistence, and not soft and cheesy as seen in enamel. After softening, the tissue undergoes disintegration, and a cavity is formed. Pigmentation accompanies the phenomena, and, as in caries of the enamel, the amount present depends to a great extent upon the slowness of the disease.

The softening or progress of the caries will differ somewhat in

individual cases, spreading in all directions, and with varying rapidity, this last depending upon the intensity of action of the various ferments, while the softening to a great extent is determined by the structure of the tooth; for in those badly developed, with a large quantity of interglobular spaces, the decay will extend laterally, undermining the enamel considerably, whilst in those where the dentine is well calcified, the decay will extend more in the direction of the dentinal tubes, giving rise to what is known as penetrating caries.

Now and then, especially in teeth of the honeycombed class, the caries extends rapidly at the junction of the enamel with the dentine, causing the enamel to break away, and leaving the softened dentine *in situ*. The general shape that the cavity assumes is conical, with the apex of the cone towards the pulp of the tooth. The softened surface of the dentine can be removed in flakes by a sharp instrument; and, when pressed upon, a small amount of moisture is exuded. When this is present in large quantity, the disease has been called *caries humida*; when it extends rapidly, *caries acuta*; when slowly, *caries chronica*; and when dry and friable, *caries sicca*.

Caries of cementum is less common than that of the dentine or enamel. It generally starts at the neck of the tooth, though it may attack any portion of the root, especially when the roots are exposed through recession of the alveolar membrane. The early stage consists in a roughness of the cementum; this is followed by softening, and afterwards by disintegration, leading to shallow cavities, which become widely distended rather than deep-seated, the reason being that there are no circumscribed points of retention or foci of decay on the root. One exception to this statement occurs, viz., the angle formed between two roots of a molar. The naked eye appearances of decay of the enamel cuticle (Naysmith's membrane) consists in a more or less pronounced discoloration of the carious part of the membrane after it has been detached by acids.

In addition to the above, two other distinct phenomena accompany caries, viz.—(1) *Transparency*, (2) *Pigmentation of the*

disintegrated parts. If we examine the dentine of a tooth in which caries is in progress, we shall find in the part situate between the pulp and the caries that the dentine appears translucent (fig. 165). This translucency is best observed in those

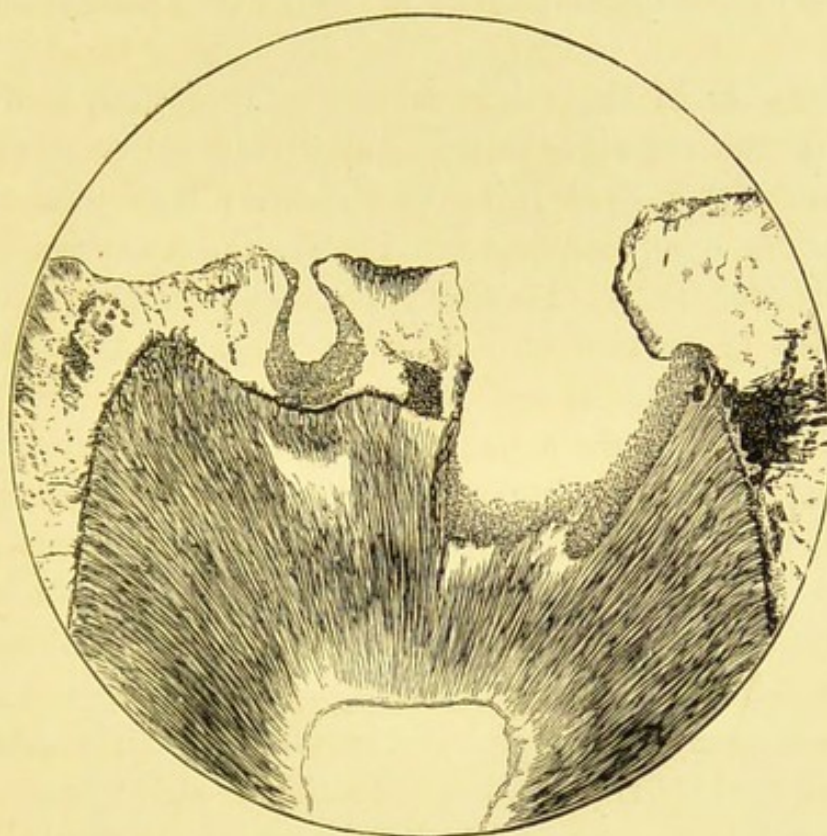


FIG. 165.

teeth where the enamel only is attacked and the dentine is perfectly free. The shape assumed is that of a cone with the apex towards the pulp, and on either side of the zone will often be seen two opaque lines. The cause of this translucency is by no means certainly known.

The dentine we know is normally tolerably opaque, the opacity being produced by a difference in the refractive indices of the matrix and contents of the tubes. If, then, anything tends to make these indices equal, we get translucency. This might be accomplished either by transforming the matrix, so as to make it resemble the contents of the tubes, or filling these latter with

materials resembling the matrix, viz., by their calcification. In favour of the latter, we must remember that a progressive narrowing of the tubes takes place after the dentine is formed ; and, secondly, that irritation of the dentinal fibrils from any source causes fresh calcification in the pulp at a point corresponding to the commencement of such fibrils on the surface of the pulp.

The diameter of the tubes, according to Miller, is distinctly lessened in the translucent zone, and chemical analysis of the translucent part proves it to be richer in lime salts than the corresponding opaque portion. Lastly, the appearance is analogous to that found in the roots of old teeth, which are well known to be rich in lime salts. Against these facts, we have the statements of well-known investigators, such as Wedl and Tomes, that all the appearances of caries, including the clear translucent zone, can be seen in teeth worn on artificial plates. Prof. Miller, however, maintains he has been unable to discover analogous phenomena in dead dentine, and on an examination of sixty human teeth which had been worn in the mouth on plates, most of which showed various stages of decay, he found only one with translucency, and even in that it was impossible to say that it had not occurred while the tooth was still living.

The pigmentation accompanying caries varies considerably in degree from a pale yellow to a black, the more acute the process, as a rule, the lighter the colour. That the discoloration does not form an active part of the process is practically certain, as it is produced solely by outside agency, and confined not only to carious teeth, but also seen in dentine free from caries. The discoloration is in all probability produced by the action of chromogenic bacteria. The chemical changes taking place consist in a decrease in the amount of lime salts, with loss also of organic matter. In analyses undertaken by Miller it was found that carious dentine contains only about $\frac{1}{3}$ of its original amount of lime salts, while the organic material is also reduced by $\frac{2}{5}$, this latter being probably due to the influence of the micro-organisms.

Microscopical appearances.—For examining enamel microscopically

pically, thin sections must be prepared by grinding, and stained to show the micro-organisms. *The enamel prisms in such sections will become more apparent, the separation from one another*

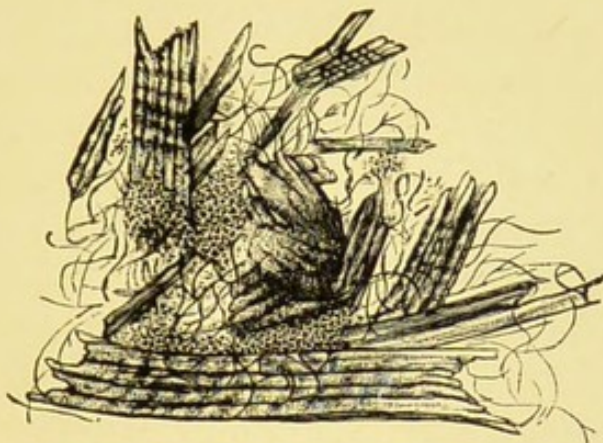


FIG. 166. Disruption of prisms in secondary enamel decay. (Miller.)

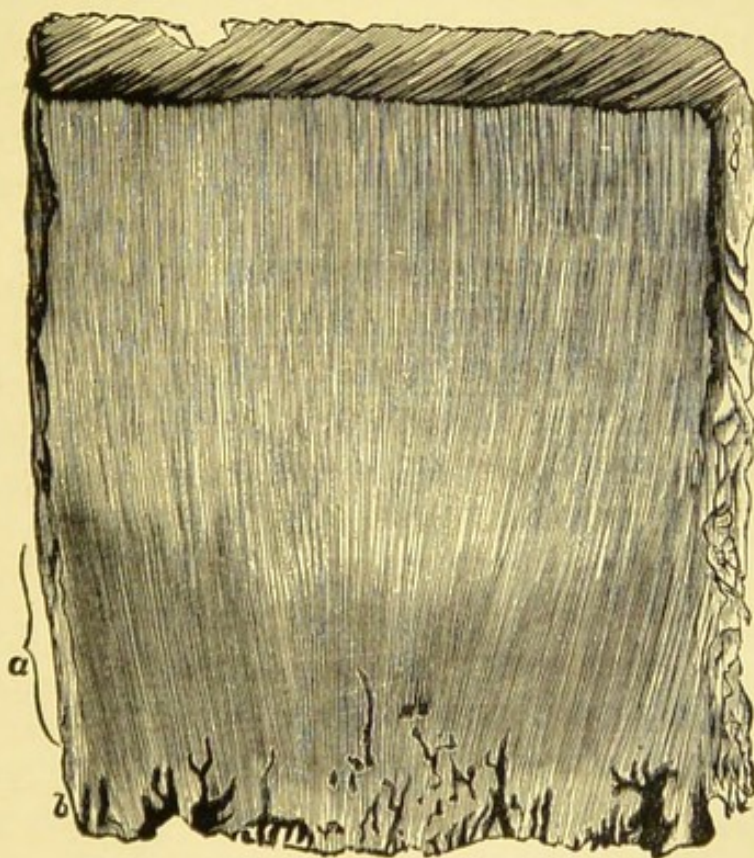


FIG. 167. Secondary enamel decay. (a) Partially decalcified enamel, which has slightly taken the staining material; (b) zone of infected enamel, showing means of micro-organisms working their way into the decalcifying zone. (Miller.)

being well marked, and the striation of the individual prisms also plainer. On approaching nearer the margin of the carious cavity the enamel appears granular, the structure having disappeared, this being the zone of partial decalcification; while bordering the margin of the cavity in the fully decalcified zone the tissue is stained deeply, which, when examined under high power, is seen to be a mass of micro-organisms. The prisms seem to be loosened by the action of the acids formed in the mouth, the bacteria, by forcing themselves between the already loosened prisms, assisting in the process of destruction.

Longitudinal sections of dentine from near the margin of the cavity, examined under lower magnifying powers, show irregular spaces, the whole section appearing stained. Lower down towards the normal dentine the fibrils appear well marked, and in places streaks of stain can be seen extending from the stained mass near the margin of the cavity (fig. 168). Under higher powers, $\frac{1}{16}$ and $\frac{1}{12}$, it can be distinctly seen that the stain, instead of appearing homogeneous, is composed of micro-organisms (micrococci, bacilli), the streaks of stain being micro-organisms situate in the dentinal tubes (figs. 170-173). In sections containing interglobular spaces these are generally seen to be filled with masses of organisms, though occasionally the interglobular spaces appear quite free from infection.

Sections of carious dentine prove that all portions are not infected, the staining not proceeding as far as the softening (fig. 174). This zone has been termed by Miller the "non-infected zone," and proves that the softening precedes the infection. The micro-organisms have a greater tendency to spread in a direction towards the pulp than laterally, though where a large number of interglobular spaces are present such is not the case. The line between the infected and non-infected zones is often well marked, and though the majority of tubes near the surface are infected, such is not the case as we get deeper down. Near the margin leptothrix is mainly found, while the tubes are generally filled with micrococci or simple bacilli.

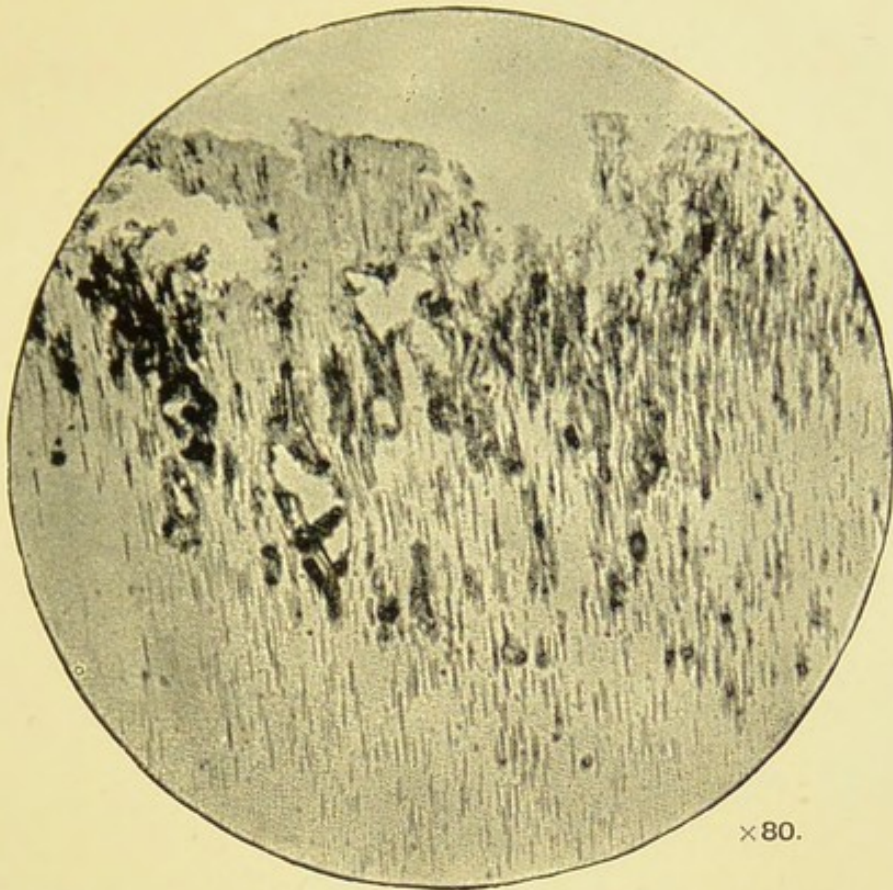


FIG. 168. Longitudinal section of carious dentine. Photo-micrograph by Mr. A. Pringle.

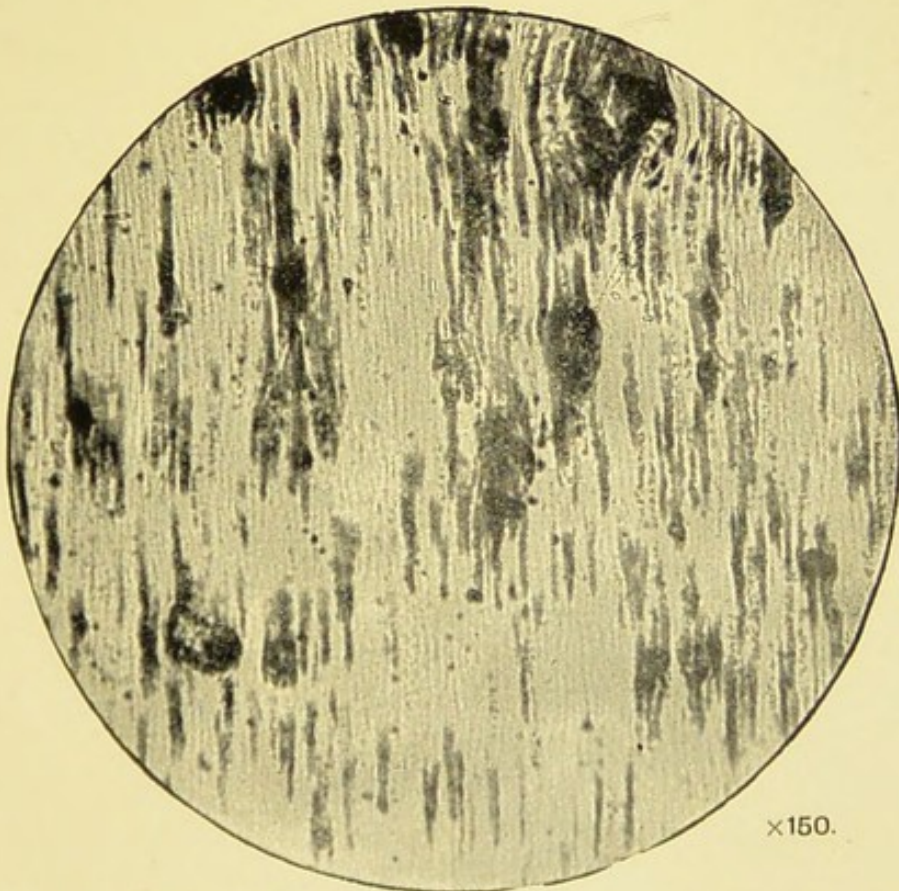
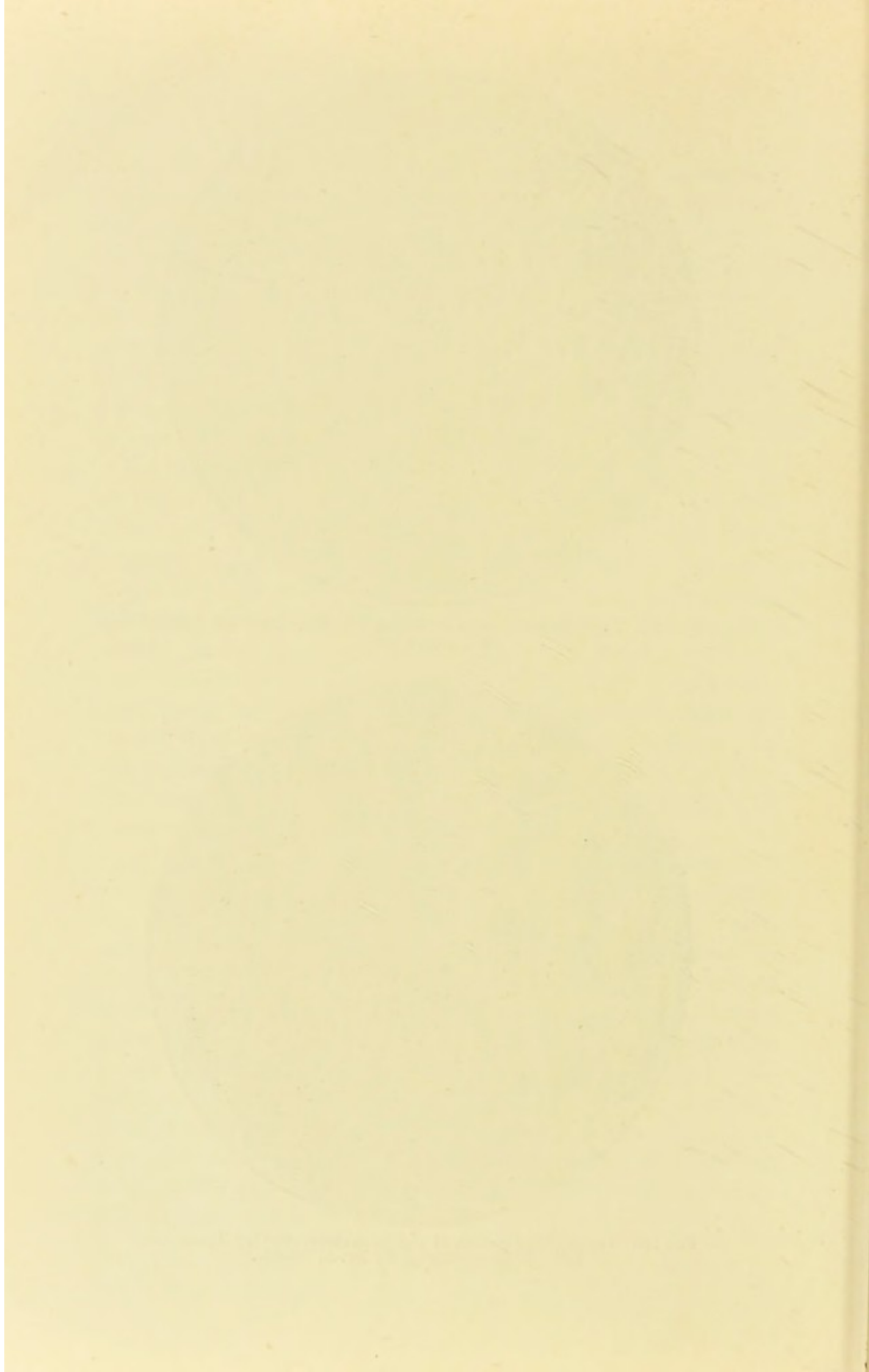
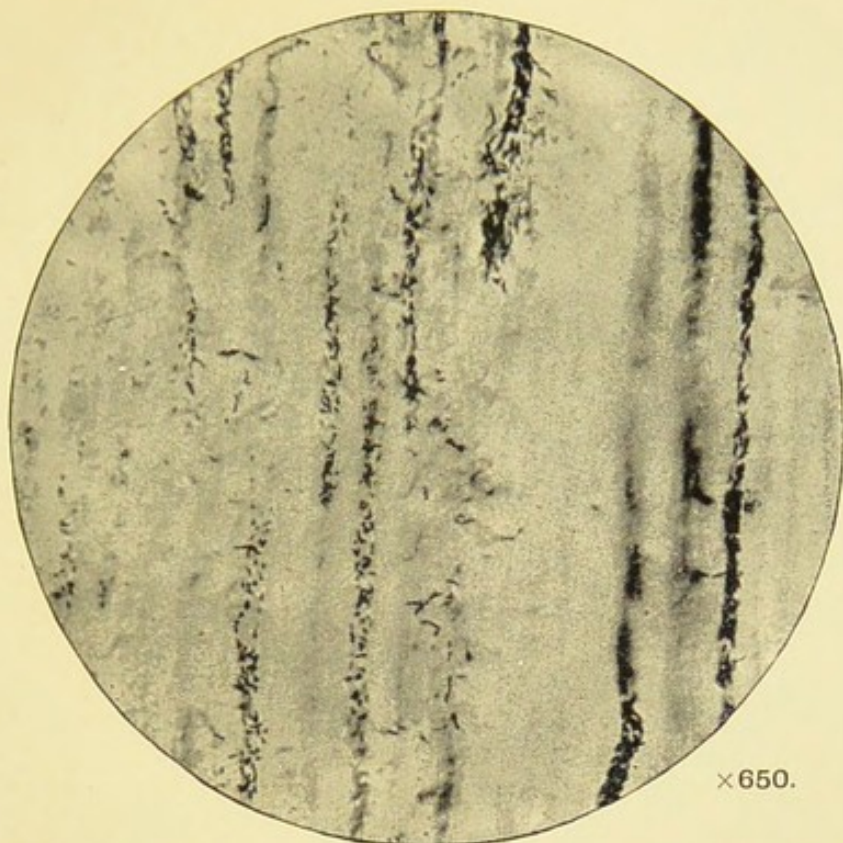


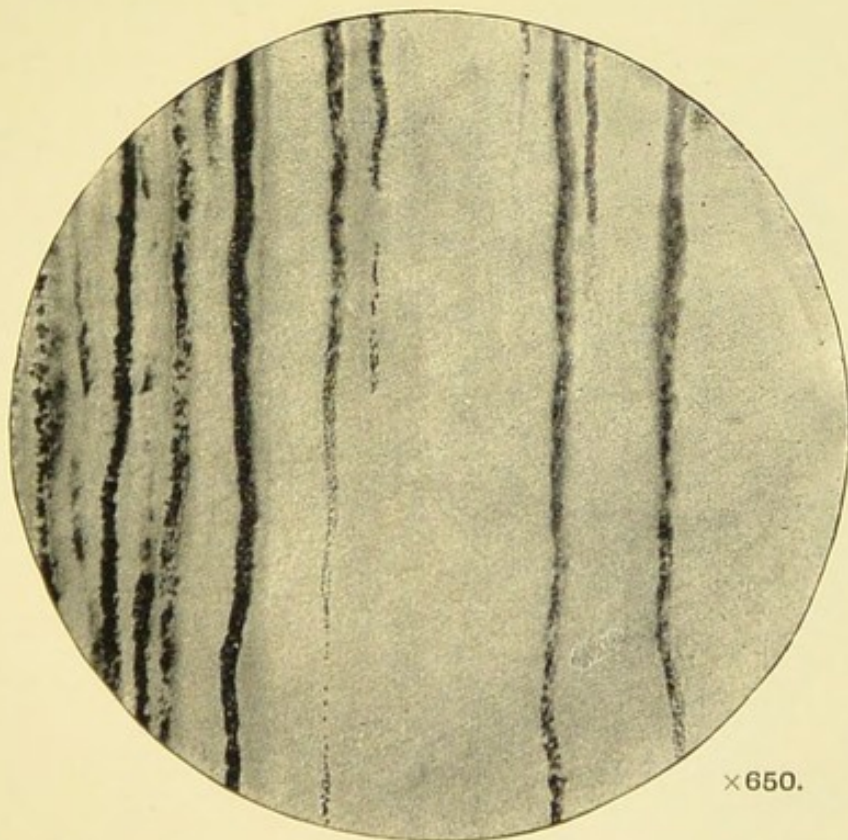
FIG. 169. Longitudinal section of carious dentine, showing liquefaction foci. Photo-micrograph by Mr. A. Pringle.





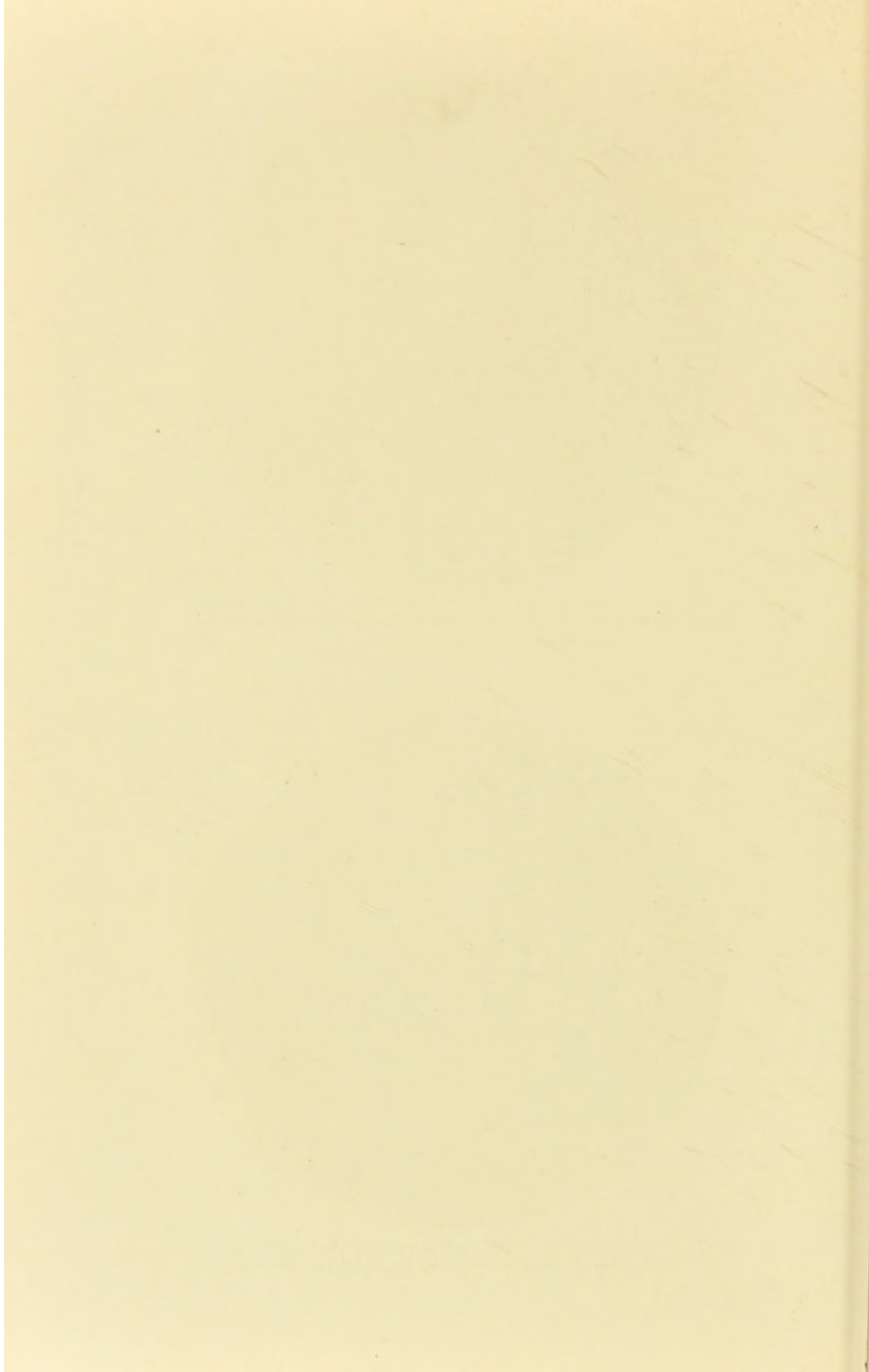
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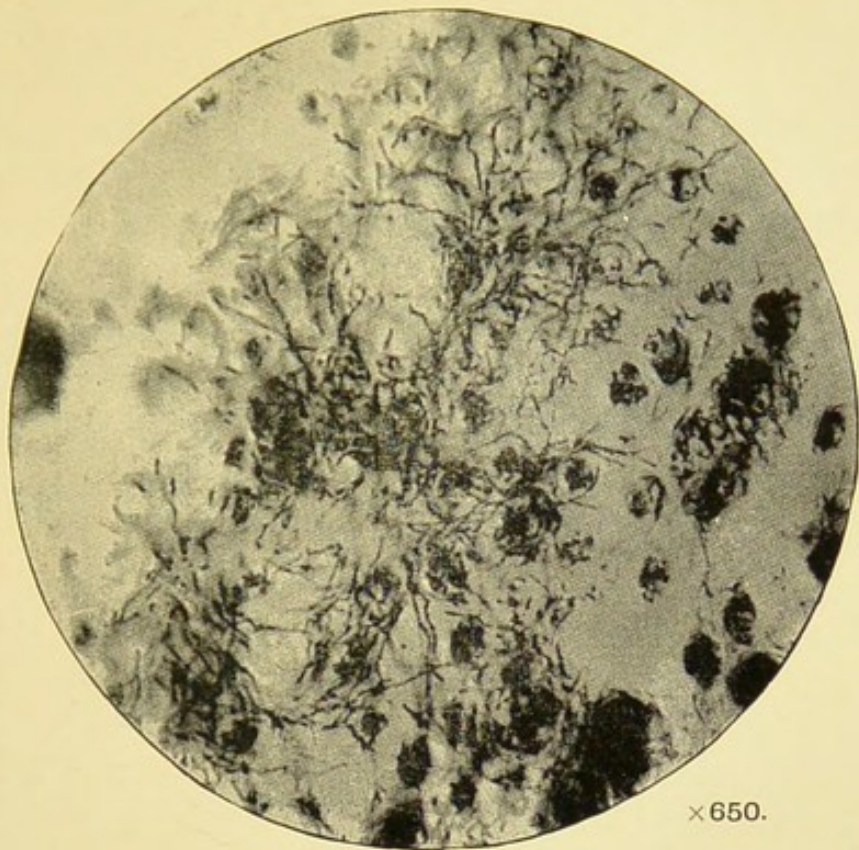
FIG. 170. Longitudinal section of carious dentine, showing rod-shaped organisms in tubes. Photo-micrograph by Mr. J. Howard Mummery.



×650.

FIG. 171. Longitudinal section of carious dentine, showing tubes filled with micrococci. Photo-micrograph by Mr. J. Howard Mummery.





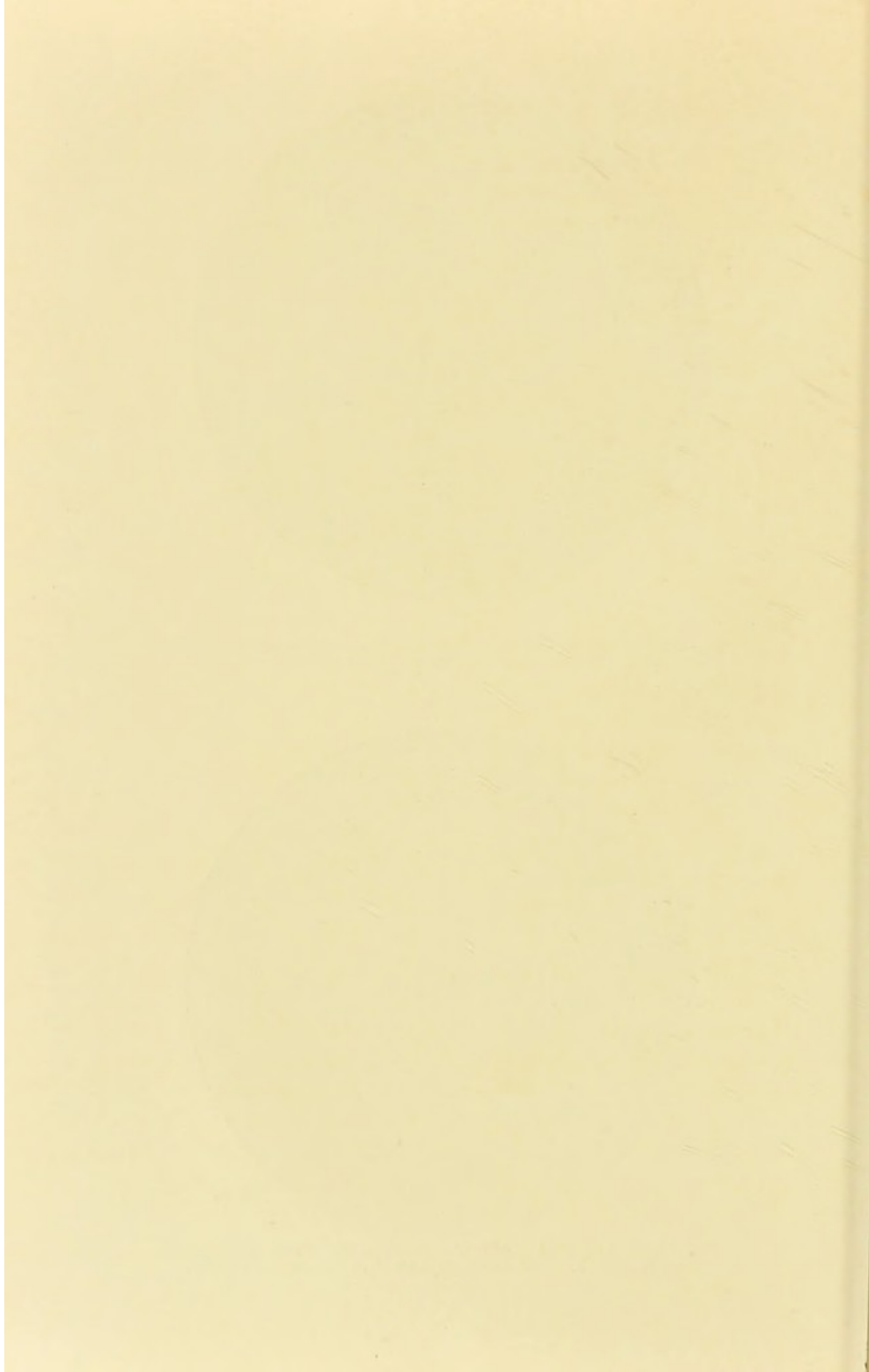
×650.

Fig. 172. Transverse section of carious dentine, showing enlarged tubes filled with micro-organisms, principally leptothrix forms.



×650.

FIG. 173. Longitudinal section of carious dentine, showing tubes filled with leptothrix. Photo-micrograph by Mr. J. Howard Mummery.



Transverse sections near the cavity show the tubes enlarged and filled with micro-organisms. In places two or more tubes become fused together by liquefaction of the basis substance,

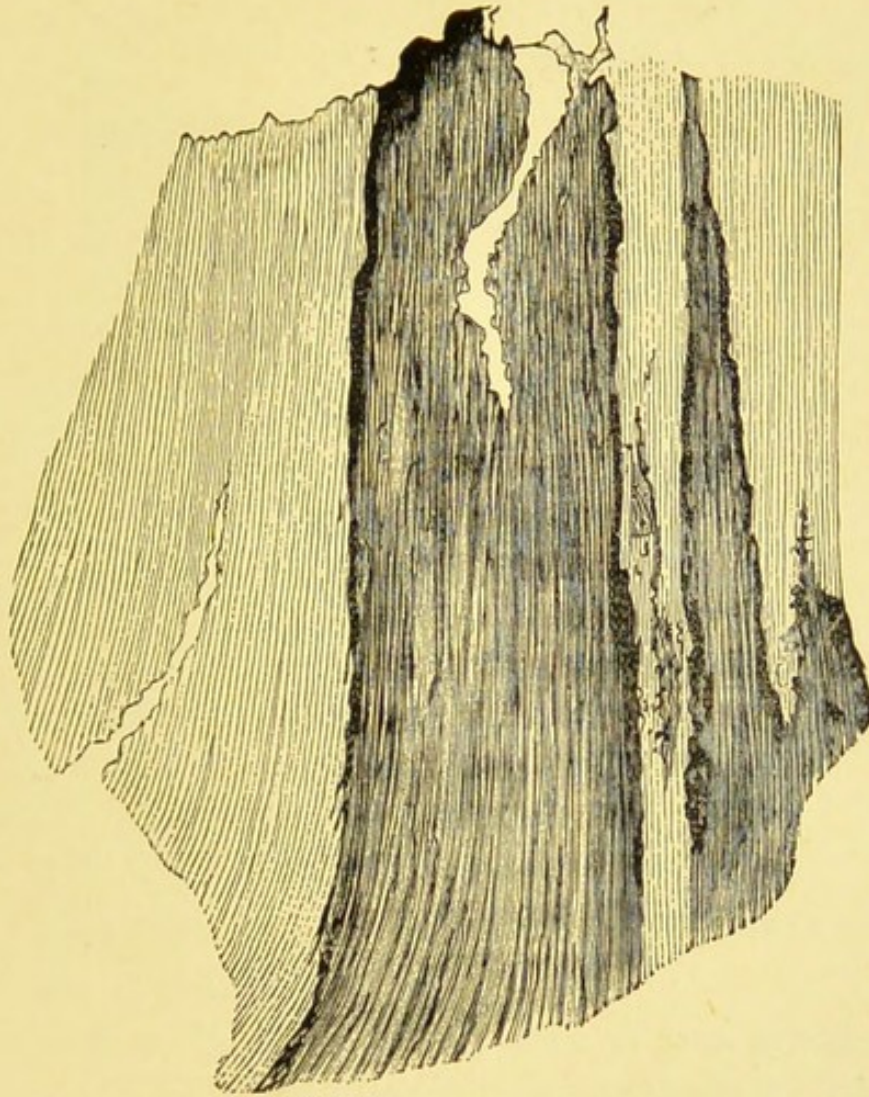


FIG. 174. Decayed dentine, showing that laterally the boundary between the infected and non-infected parts may be very regular. (Miller.)

forming irregular spaces or caverns. One cavern then joins another, and so the dentine becomes broken up. These caverns are found to be packed with masses of micro-organisms, and are designated by Miller as liquefaction foci. This condition is also well marked in longitudinal sections (fig. 169). The intervening substance is dissolved by bacteria, which have a peptonising power. In transverse sections taken nearer to the normal

dentine it is found that the sheath of the dentinal tubes is considerably enlarged, this being probably due to decalcification. The appearance of the dentine thus produced has been termed the *tobacco-pipe* appearance (Tomes). This is shown in fig. 175,

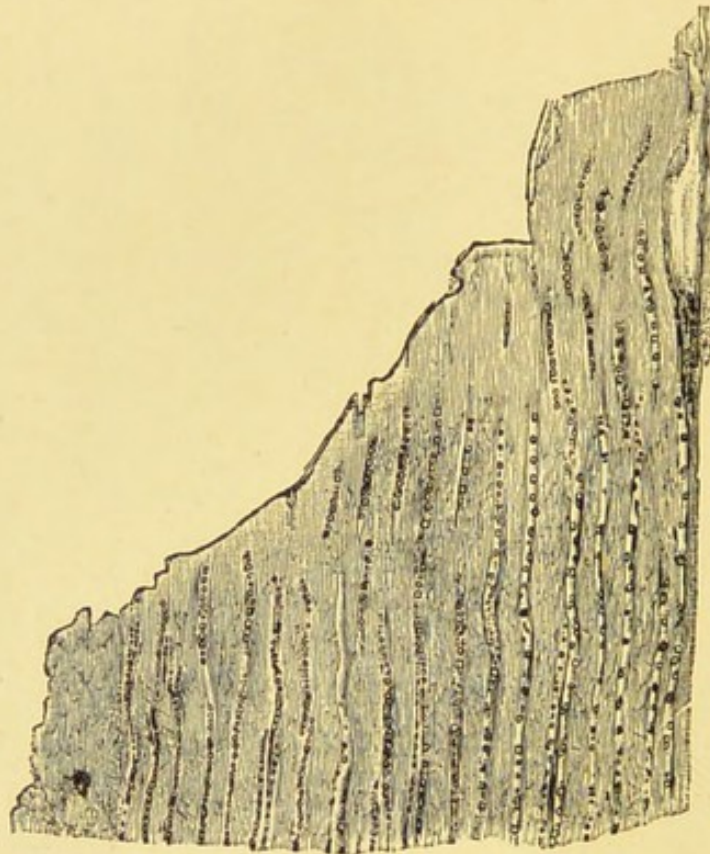
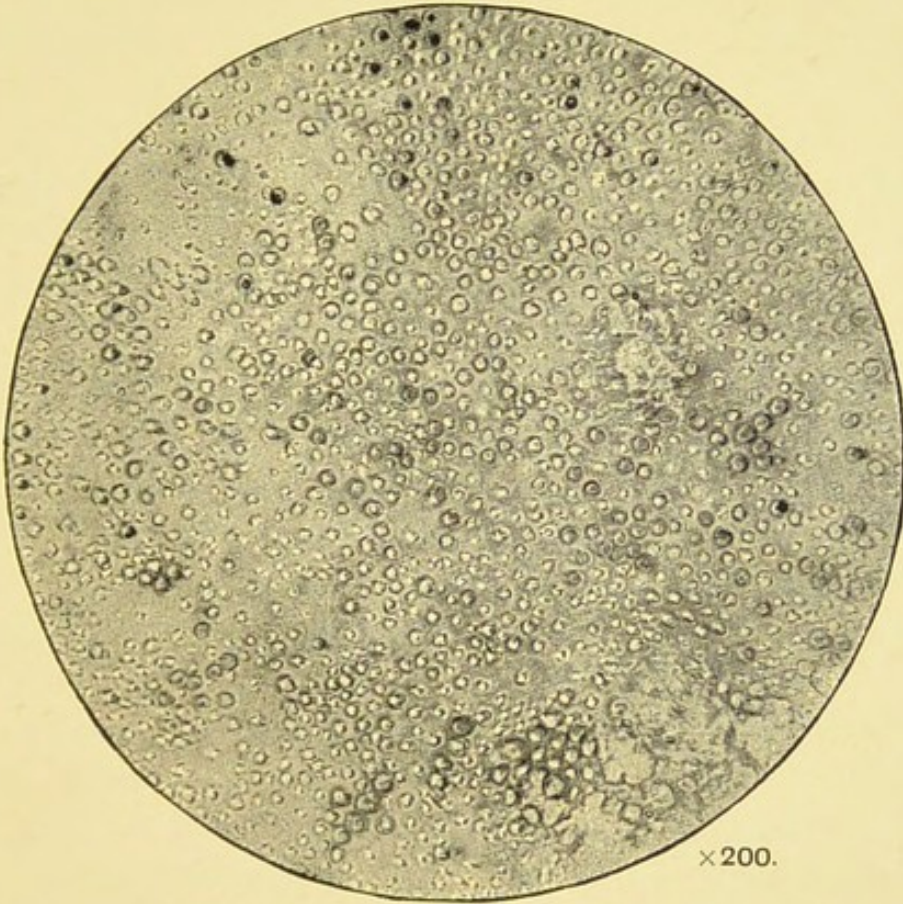


FIG. 176. Row of shining granules in the tubules, from decay of a tooth worn on a plate. (Miller.)

and can also be seen in caries occurring in teeth used as artificial substitutes, and in caries produced artificially.

In longitudinal section many of the tubules are found to contain *rod-shaped fragments or elements*, and these are also seen in artificially-produced caries. These elements, the source of which is not distinctly proved, have been supposed to be either (*a*) portions of consolidated fibrils; (*b*) pieces of the sheaths of Neumann; (*c*) casts of the enlarged fibrils. Miller finds that when brought into contact with inorganic acids (dilute sulphuric acid) the elements immediately disappear, but when organic acids are used these elements become more distinct; he therefore thinks



×200.

FIG. 175. Photo-micrograph by Mr. A. Pringle.



that they are probably lime formations. *Rows of shining irregular granules* are also met with, generally in the zone, in advance of the caries (fig. 176). It is possible that they have the same origin as the rod-shaped elements, for, if these be crushed, grains can be produced.

Decay of cementum resembles in some details that of dentine. Following the decalcification of the tissue, an invasion of bacteria takes place, the intervening substance being gradually dissolved and destroyed.

The effect of caries upon the pulp may be briefly described as causing a renewed activity, leading to the deposit of fresh tissue (secondary dentine). This portion of the subject will, however, be referred to in further detail when dealing with the pathology of the dental pulp.

Artificial decay.—Attempts to produce artificial decay of teeth have been made by many investigators with more or less success, but it has fallen to the lot of Miller to produce it in a manner which macroscopically and microscopically is indistinguishable from ordinary caries. Milles and Underwood made early attempts to produce artificial caries, and came to the conclusion that it was impossible. Carious teeth, in a mixture of milk, bread, meat, and saliva, were kept in an incubator for six months at the normal temperature of the body. At the end of this time no change was found to have taken place in the teeth, but the mixture during the period underwent putrefaction, and, as Miller has pointed out, naturally became alkaline. In a second experiment, saliva and milk were used with the same result.

Magitot, in an extended series of experiments, produced artificial caries which to the naked eye resembled ordinary caries. Miller, for his experiments, kept teeth in a mixture of saliva and bread at 98° Fahr. for a period of three months. To produce artificial caries about one ounce of a mixture of one part of bread with eight of saliva should be taken, and the teeth should be immersed in it in a glass stoppered bottle, and the whole kept at a temperature of about 94° to 98° Fahr. Each day the bottle should be opened for a few minutes, and should the

mixture become putrid, the teeth should be washed and placed in a fresh solution. This latter is most important, as in the putrid condition the mixture becomes alkaline. The caries, though attacking the tooth all over, advances more quickly where there are any inherent flaws or fissures. In sections cut from such teeth it is found that the micro-organisms do not give the violet reaction with iodine which is the case in organisms occurring in sections from ordinary teeth.

Concerning artificially produced caries, a slight difference of opinion exists as to the presence of the transparent zone. Tomes in the last edition of his *Dental Surgery* states that it is present, Miller being of the opinion that it is not. Miller further holds that its absence, in his opinion, does not tend to show that caries of such teeth is different to that occurring in living teeth, for he regards the transparency as forming no essential part of the process of caries, it being found under a variety of other conditions, for example, in those teeth which have been the subject of attrition or abrasion.

Ætiology.—The causes of dental caries may be divided into predisposing and exciting, and the former subdivided into local and general.

Predisposing—Local.—The local predisposing causes of caries may be grouped into three distinct classes. The first are those connected with *the defective formation of the teeth themselves*. There may be a general deficiency of lime salts, with an undue abundance of organic matter, rendering the teeth more vulnerable. An example of this may be seen in the temporary teeth, which, containing a less quantity of lime salts than the permanent, are found from clinical observation to be more prone to caries. An increased number of interglobular spaces, or the passage of dentinal tubes into the enamel, will also act as predisposing causes; also the actual shape of the tooth, such as the presence of pits, crevices, and prominent cusps, allowing the lodgment of particles of food. This latter is well exemplified by the frequent occurrence of caries upon the crown surfaces of molars, bicuspid,

and palatine surfaces of incisors, when pits exist or when the enamel is very thin or altogether absent.

The relation of one tooth to another is an important factor in the process. When in a regular position the tongue and lips, and such artificial means as the tooth-brush, silk, and tooth-pick, are easily able to keep the surfaces free and clean; but when the teeth are placed irregularly, crevices are formed which are inaccessible. Again, the teeth, when normally placed, only just touch one another, and the space at the necks is occupied by gum, which prevents the lodgement of food. Anything, therefore, which alters this condition, such as the loosening and recession of the gum, will naturally act as a predisposing cause.

A third group of local causes is to be found in *abnormal conditions of the secretions of the mouth*. These act by rendering the saliva acid, as is frequently seen in dyspeptic people, or by making the saliva more mucoid, thus allowing it to cling more easily to the teeth, this excess of mucus allowing it to undergo fermentation quicker. This mucoid condition of the saliva is frequently seen in many fevers, such as rheumatic and typhoid, and is brought about more by the arrested secretion of the other elements of the saliva than by an excessive secretion of the mucus.

General.—*Hereditary influence* is well marked in many cases of caries, and this may be by transmission of some abnormality in form or by direct deficiency of lime salts. So well is this hereditary influence marked that it is not exceptional to see one special tooth in a family prone to attacks of caries.

Pregnancy is said to act as a predisposing cause, and it is generally stated as such in works on midwifery; but though many women seem certainly to suffer from caries at this period, it should be remembered that there are many instances of women with large families who have perfect sets of teeth and who are free from dental trouble during the period of pregnancy.

Certain occupations predispose to caries. This is well shown in the case of bakers and millers, who are especially liable to

this disease; and in alkali workers, who are exposed to the fumes of acids during the process of manufacture, the teeth are said to become blackened and rot away.

Civilisation is certainly another cause, and this acts in a variety of ways, the principal of which are the cuisine of the present date, which nearly reduces the use of the teeth to a minimum for mastication purposes; and more particularly the activity of the brain, which, as pointed out in the preface, tends to reduce the standard of the teeth.

The class of food used indirectly exerts an influence, and this depends upon its liability to undergo fermentation; for it is found that meat-eating tribes are practically free from caries, while in those whose staple food is carbo-hydrates such is not the case. The chemical composition of the food exerts its influence, and the effect on the teeth of such liquids as cider is well known.

The general feeding of the child in infancy has already been dwelt upon, and there is no doubt it plays an important part; but in one case which came under the notice of the authors every attention to the early feeding of the child had been paid with but little result. In this case there was, however, well marked hereditary influence, both parents being much predisposed to caries.

Rheumatism, gout, diabetes, dyspepsia, and rachitis have by various authors been mentioned as predisposing causes; but it is extremely doubtful if they exert any other influence but that of producing abnormal conditions of the saliva. It is also questionable whether climatic or telluric conditions play any part in the indirect causation of caries.

Direct causes.—Miller says, in his work on *Micro-organisms of the Mouth*, that “dental decay is a chemico-parasitical process consisting of two distinctly marked stages: decalcification or softening of the tissue, and dissolution of the softened residue. In the case of enamel, however, the second stage is practically wanting.”

The acids by which the process of decalcification is produced are mainly derived from the fermentation of carbo-hydrate substances, the principal acid formed being lactic acid. It is found

that the formation of acid takes place more quickly in the presence of starch and sugar. In the process of conversion the starch is transformed by the ptyalin of the saliva into grape sugar and then into lactic acid.

Experiments have proved that when fermentable albuminous materials are combined with saliva but little acid is formed, which soon disappears; while, when the putrefaction of albuminous substances takes place, such as meat, in the mouth, acids are not formed. Raw vegetable food is less prone to fermentation than when cooked.

When once decalcification by means of the acids has taken place, the remaining organic portion of the tooth substance is dissolved by the action of bacteria, which perform their work by acting upon the dentine in much the same way as the pepsin of the gastric juice acts upon albuminous materials. No special organisms can as yet be shown to be always present in dental caries; the researches of Vignal and Galippe seem to suggest that such organisms probably do exist. In eighteen carious teeth examined by them, four different kinds of bacteria were found in all cases, while a fifth variety appeared in half the cases and a sixth in five. Miller is still carrying on investigations, the results of which are as yet unpublished.

This view of the direct causation of dental caries is usually known as the chemico-parasitic one, and is that which at the present time is generally accepted. In support of it we have the facts that in caries micro-organisms are always present, and the liquefaction foci producing the cavern-like spaces are not found if bacteria are absent. In teeth acted upon solely by acid only a softening of the tissues takes place, and nothing like real caries; while if a tooth be artificially exposed to both germs and acids, caries is produced in every respect resembling the ordinary disease. Against this view the principal argument that has been advanced is that one would expect to find caries progressing in cases of putrid pulps, but the bacteria under such conditions either perish or become inactive; secondly, there is no carbohydrate material in the pulp, and this is found needful for the

formation of acids ; lastly, a putrid pulp is nearly always alkaline in its reaction, which necessarily checks the action of these micro-organisms, since their activity can only exist in the presence of free acid.

Various other theories have been advanced to account for the phenomena of caries. The *inflammatory* theory, which has received the support of Abbot, Heitzmann, and Bödecker, who endeavour to explain the process by assuming the presence of inflammation, maintaining that an actual inflammation takes place even in the dentine. Many conclusive arguments can be urged against this view, and the microscopical appearances, which by these observers have been used in support of it, are in reality produced by masses of micro-organisms.

The *electrical* theory, advanced by Bridgeman. He says the crown of the tooth forms one pole and the root the other, the electrolyte being the saliva ; and in abnormal conditions of this latter electrical action takes place, resulting in the abstraction of lime salts from the positive pole by the action of acids in the saliva.

The *chemical* theory supposes caries to be due solely to the action of acids. The first stage of caries we know is practically the result of acid action only, but it is impossible to produce caries in dentine without the presence of micro-organisms, the action of the acid resulting in simply a decalcified framework of the tooth.

The *parasitic* theory, the best exponents of which in recent years have been Milles and Underwood, would ascribe all the phenomena of caries to micro-organisms ; to use their words, they consider that "two factors have always been in operation : (1) the action of acids, and (2) the action of germs. This theory—which for the sake of distinction may be called the *septic*—is rather an amplification of the chemical theory than a contradiction of it. Most probably the work of decalcification is entirely performed by the action of acids, but these acids are, we think, secreted by the germs themselves, and the organic fibrils upon which the organisms feed and in which they multiply

are the scene of the manufacture of their characteristic acids, which in turn decalcify the matrix and discolour the whole mass."

Arrested decay.—At times caries undergoes spontaneous arrest. The causes leading to this are obscure. This condition appears more frequently in the first permanent molar than in any other tooth, though at times all the teeth are thus affected. They are frequently those in which the honeycombed condition has existed, and which have been attacked by a superficial caries, the enamel of the masticating surface and often the sides being completely destroyed, while the dentine is left remaining, but discoloured. As long as caries proceeds in such cases, the dentine will be found quite soft to the probe; but if the disease undergoes spontaneous

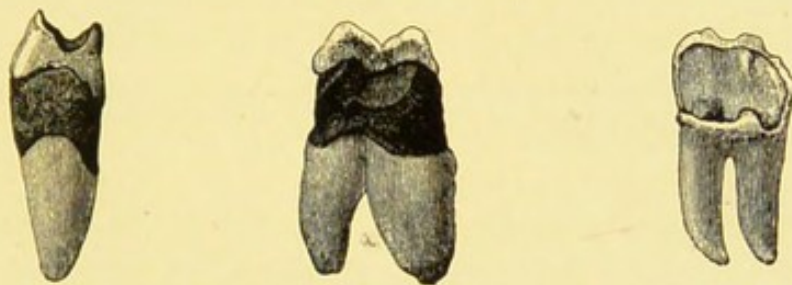


FIG. 177. Teeth showing arrested decay.

arrest, the dentine will be found to become as hard, if not harder, than normal. Patients in whom this change takes place have nearly always undergone some marked improvement in both health and surroundings, and in a case occurring under notice a patient who presented himself with practically all his back teeth in an advanced condition of caries was recommended to have them removed; this was not done, and subsequently he went for a long sea voyage; on returning after a lapse of one year the caries was found to have undergone spontaneous arrest. Viewed microscopically, teeth in which this condition exists present little that will help to solve the problem. The dentine retains the colour of carious dentine, or is perhaps rather darker. The surface is irregular, the dentinal tubes which can easily be seen in the discoloured part apparently ending abruptly

on the surface. In the four sections examined staining had failed to show any micro-organisms, except at those spots where caries was recommencing, and the translucent zone was exceptionally well marked. A section of such a tooth is shown in fig. 178.

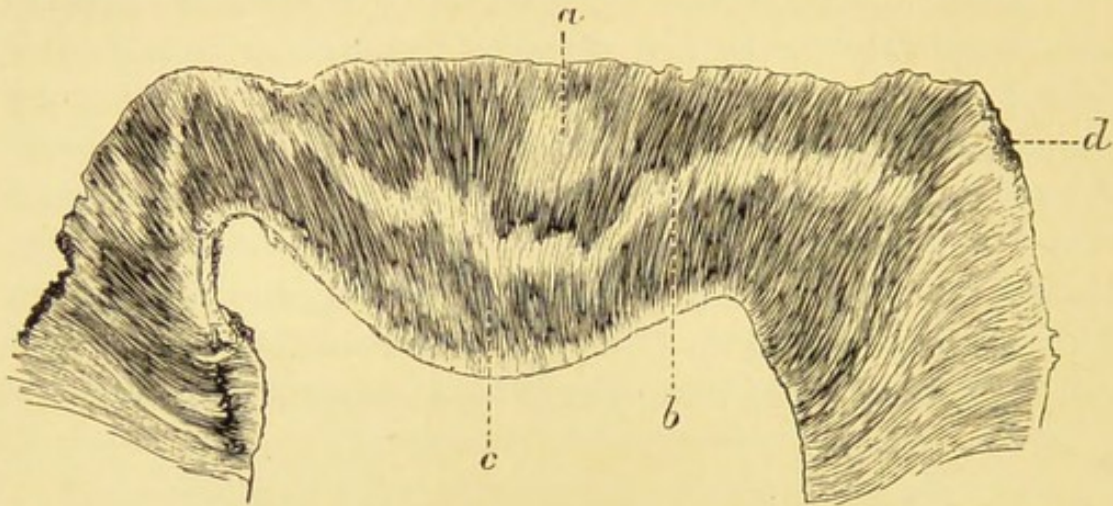


FIG. 178. (a) Portion of dentine in which the decay has become arrested; (b) translucent zone; (c) normal dentine; (d) a softened patch of dentine showing micro-organisms.

It is difficult to see exactly what can bring about the arrest. General improvement in health is no doubt an important factor, and this indirectly improves the local condition existing in the mouth, preventing the development of acids and growth of bacteria; but how the hardening of the softened dentine is brought about is a more difficult problem. Some have assumed it to be the result of dehydration of the dentine, but this is difficult to understand when it is recollected that the teeth are constantly bathed in moisture. It seems far more probable that it is due to some vital action on the part of the tooth, and with this view it would be interesting to note if the condition is ever seen in caries proceeding in dead teeth.

Symptoms and diagnosis.—The *symptoms* of caries in its early stages are few, and arise from simple exposure leading to irritation of the dentinal fibrils, so that at times the slightest changes of temperature, or the introduction of sweet substances, etc., produce twinges of pain, but in the later stages the pain is at times acute. The amount varies in different people. In some,

caries in an advanced stage leads to no pain, while in others a small cavity will give rise to severe attacks. The extent of pain differs in different temperaments, being marked in those of nervous disposition. Worry and severe illness also seem to predispose to it. It will be noticed that often in some cases of caries there is a certain amount of pain at first, which diminishes as the trouble advances. It will also be found that the superficial layer of carious dentine is frequently more sensitive than the deepest, and that certain spots may be extremely painful, notably at the point of junction of the dentine and the enamel.

The *diagnosis* of caries can generally be made without much trouble. Many cavities admit of no doubt, but if any uncertainty exists, a careful examination must be made. Fine curved probes should be used; in searching for cavities the approximal surfaces of the bicuspid and molars should be especially examined, and in using the probe care taken not to mistake for cavities the curve of the tooth or the presence of tartar at the neck causing the probe to catch. For cavities, another guide in diagnosis is the colour of the enamel: when a bluish white colour is present, it should always be regarded with suspicion. In doubtful cases a strand of silk passed between the approximal surfaces of the suspected teeth will be of assistance, for if a cavity exists, the silk is nearly certain to be torn or frayed. Caries in the approximal surfaces of the front teeth can generally be diagnosed by the opacity produced. There is a condition in bicuspid and molars which appears like decay; it occurs when the tooth is wearing down, and is produced by the light shining through the edge of enamel. The mouth mirror with the electric light attached will be found useful in the diagnosis of doubtful cases of interstitial decay. By this means the tooth appears translucent, but opaque at the seat of caries.

Treatment.—The treatment of caries may be divided into (1) prophylactic, (2) remedial. The prevention of decay may be accomplished by careful attention to the hygiene of the mouth. The teeth should be cleansed, if possible, after every meal, and especially both morning and evening.

It has been seen that acids and bacteria are the exciting causes of decay; it therefore follows that any tooth powders or mouth washes used should contain both antacids and antiseptics. The tooth-brush used should be small, and contain fewer hairs than are seen in the majority of tooth-brushes, and the bristles should not all be of the same length, so as to allow them to pass more easily into the interstices of the teeth. It should be used with an upward and downward movement, viz., in the direction of the long axis of the teeth, crosswise and circularly. Not only should the outside of the teeth be cleaned, but also the masticating surface and the lingual surface; and, if a curved brush similar to that shown in fig. 179 be used, it will be found possible to keep

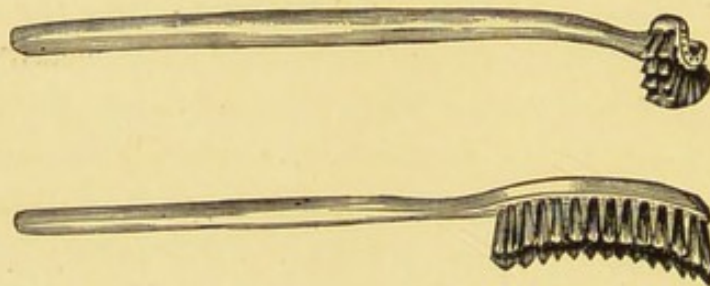


FIG. 179.

the tartar to a great extent from depositing upon the lower incisors. In addition to the brushes, silk dipped in some antiseptic solution should be passed regularly between the teeth, as by this means decay on the approximal surface will be to a great extent prevented.

In cases of acute fevers, or any condition where the patient is unable to cleanse the teeth, the attendants should do so for them, and the same rule applies to children. All foods which are specially liable to ferment, producing acids, or which may be acid themselves, should be avoided; or, if taken, the mouth should be well rinsed afterwards with some alkaline and antiseptic solution.

Crowding should be remedied by the extraction of some of the back teeth, as above mentioned (see p. 50); this allows the teeth

to separate, and so permits the approximal surfaces to be more easily filled and to be kept cleaner—points of much importance.

Patients wearing artificial plates should be instructed to keep all clasps, etc., quite free from food, and all dentures should be cleaned after every meal. The surfaces of the teeth which come in contact with the artificial ones should be cleaned with silk or lint, as the food which collects in this region is a frequent cause of caries.

A crow-quill toothpick in the majority of cases may be used with advantage, as by this means débris of food is removed and fermentation prevented.

The following prescription for tooth-powders, mouth-washes, etc., may be found useful.

TOOTH POWDER.

R.	Saponis Hisp.,	-	-	-	-	-	-	-	-	ʒij.
	Pulv. iridis,	-	-	-	-	-	-	-	-	ʒiij.
	Os. sepia pulv.,	-	-	-	-	-	-	-	-	ʒij.
	Cretæ præcip.,	}	-	-	-	-	-	-	-	āā ʒij.
	Mag. carb. pond.,									
	Ol. eucalypti,	-	-	-	-	-	-	-	-	ʒviij.
<i>Altar</i>	Otto rosæ,	-	-	-	-	-	-	-	-	ʒviij.

FLUID DENTIFRICE.

Tincture of Quillaia with 1 p.c. of Benzoic Acid.

Send 1½ ounce.

Several varieties of soap dentifrices are made, of which those manufactured by Messrs. Bell & Co., of Oxford Street, the O. S. tooth block and S. S. White's tooth soap are the best.

MOUTH WASH.

R.	Tinct. Calendulæ,	-	-	-	-	-	-	-	-	ʒj.
	Aquam ad	-	-	-	-	-	-	-	-	ʒviij.

ANTISEPTIC (FOR DIPPING SILK).

Mercuric chloride in absolute alcohol, - - 1 in 1000.

Send ½ ounce.

The remedial treatment of caries consists in either performing the operation of excision or filling, both of which proceedings will be detailed in the following chapter.

CHAPTER VII.

TREATMENT OF CARIES.

EXCISION.

IN the *operation of excision* the diseased part is cut away, and the surface polished. It is applicable in but a few cases, the most suitable being the approximal surfaces of the molars and bicuspid, when the caries is quite superficial and these surfaces are exposed. It may also, under similar conditions, be performed on the front teeth.

The operation is best carried out with thin corundum wheels on the dental engine, and the surfaces left should be so shaped that they can be easily cleaned. After cutting away the carious tissue, the exposed surface should be carefully polished with Arkansas stones, pumice, etc. After the operation the teeth are often a little sensitive; this can be relieved by the application

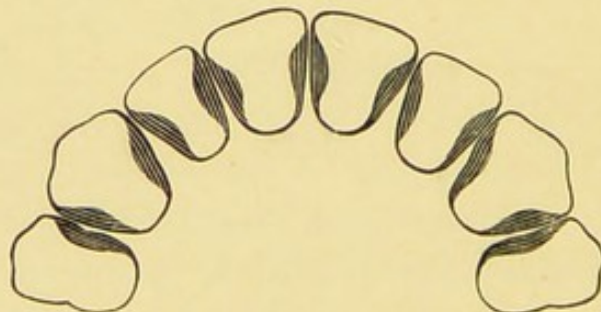


FIG. 180.

of absolute alcohol. Some practitioners employ excision extensively, cutting away large portions of the tooth. The spaces

thus formed should be V-shaped. In the case of the incisors, the base of the V is towards the lingual surface of the teeth. This operation is extensively employed by Dr. Arthur, and fig. 180 gives a good idea of the shape of the surfaces left after the operation.

FILLING.

This operation will be considered under the following headings:—

- (1) Exclusion of saliva.
- (2) The methods of separating teeth.
- (3) The preparation of cavities.
- (4) The treatment of sensitive dentine.
- (5) The use of matrices.
- (6) The relative value and uses of the different filling materials.
- (7) The introduction of the various filling materials.

(1) **Exclusion of Saliva.**—The exclusion of saliva during the operation of filling is of the greatest importance, and in order to effect it, various mechanisms and methods are in vogue, including the use of napkins, bibulous paper, saliva pumps, rubber dam, etc. Of these the *napkin* is the oldest, and with many the favourite method; its place is, however, being taken by the more effective method, the use of the rubber dam. The rubber dam, however, is not at all times applicable, and then resort must be had to other methods, and the napkin properly applied will often be found very effective. It should be made of the best diaper, fairly thin, and not too large, and it is as well to have a selection of various sizes. There are many ways of applying it, but the one described as follows will be found especially useful:—Fold the napkin into the shape shown in fig. 181, and take hold of it with a pair of conveying forceps about $1\frac{1}{2}$ to 2 inches from the pointed end; if applying to the upper teeth pass it up into the sulcus between the gum and the cheek in the region of the molars, and continue to pack the short end well up in the sulcus, bringing it forward, the remaining or bulky portion being passed

behind the molars and spread out as shown in fig. 182 (a). While working, the operator should keep his finger well pressed on the part of the napkin which lies over the opening of Steno's duct.

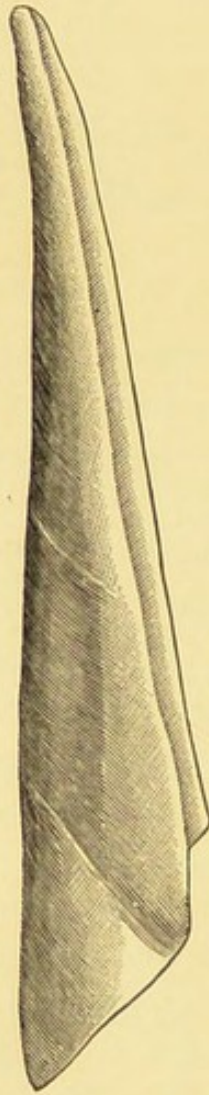


FIG. 181.

In applying to the lower jaw exactly the same proceeding should be adopted, the bulky portion being well pressed down into the floor of the mouth, and it is as well to let the tongue lie over the napkin, rather than the napkin over the tongue, as this will tend to keep the napkin *in situ* (fig. 182 (b)).

In connection with the napkin, Mr. Ackery has recommended placing in the folds a thin sheet of rubber dam. The use of this

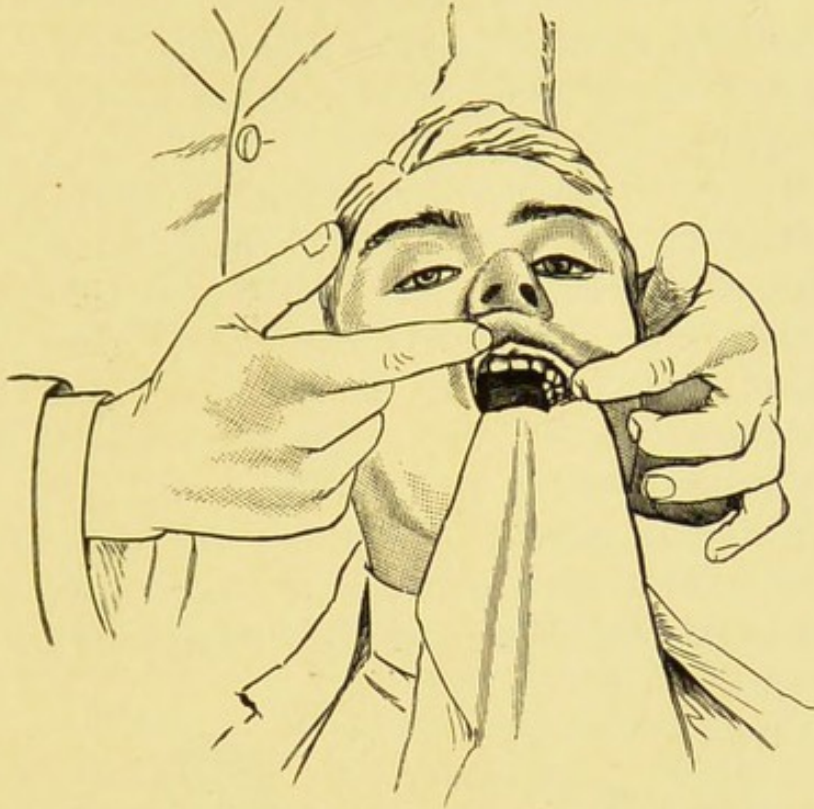


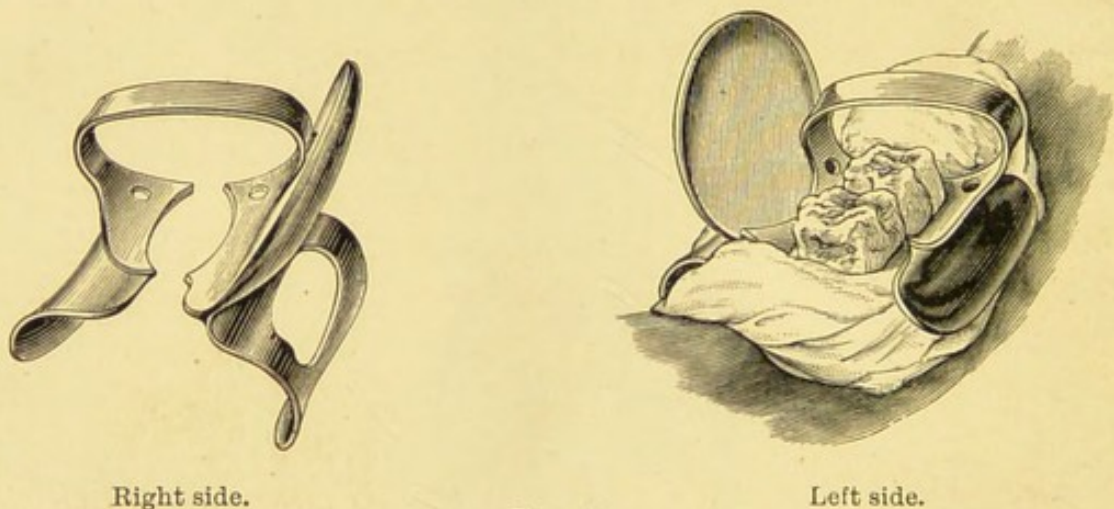
FIG. 182 (a).



FIG. 182 (b).

is plain. The ordinary napkin gets moistened, and gradually the whole thickness of it becomes saturated. If the rubber is used this will not happen, the side of the napkin against the tooth being kept practically dry.

Bibulous paper or *amadou* is now used by many operators in place of napkins, and is applied by simply packing pledgets of the material used on either side of the gum, holding them in position either with the finger and thumb or some mechanical contrivance. In the lower jaw a pad should be placed underneath the side of the tongue. The depots have recently introduced rolls of cotton-wool about $1\frac{1}{2}$ inch long, and they are certainly an easy and neat method of applying this class of material. In connection with the napkin and bibulous paper, clamps are extremely useful, that shown in fig. 183 being after the design of



Right side.

FIG. 183.

Left side.

Mr. C. Stokes. When in use, the clamp should be placed in position, and a roll of bibulous paper passed through the hole in the lip of the clamp, taken round the back of the tooth, and returned under the plain lip of the clamp. When the rolls become moistened additional paper should be packed under the lips over that already in position.

When only a napkin is used and not the rubber dam, moisture appears between the necks of the teeth, coming from the glands near the margin of the gum, which is extremely troublesome. A

very excellent plan for controlling this is recommended by Mr. Matheson, who ties to little square pledgets of amadou a small piece of waxed silk; the silk is passed between the teeth, and the amadou drawn into position between the teeth.

The *saliva ejector* is another method of removing moisture, and is especially useful in conjunction with other methods.

The comfort to the patient and the operator by the use of this instrument cannot be over-estimated. The mouth tubes for use with these instruments are usually made of glass or metal nickel-plated. The latter is preferable, because the glass tubes are difficult to clean thoroughly, and are rigid and friable, the nickel-plated ones being stronger and easily bent when necessary. The necessity of thoroughly cleansing the tube after use by letting a glassful of water (with, if preferred, some dilute antiseptic) pass through it is of importance. It is also a good plan, before adjusting it to the patient's mouth, to allow some water to pass through the tube from a glass. When using the rubber dam, saliva ejectors are most useful, the patients frequently, with the dam applied, finding great difficulty in swallowing. Saliva ejectors with specially-made clamps form a very efficient means of excluding moisture during short operations. The clamps (fig. 184) are very useful, and are after the design of

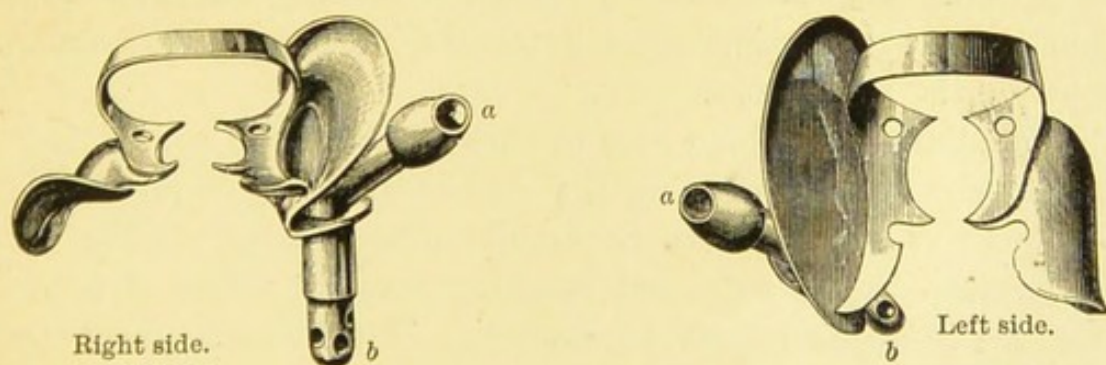


FIG. 184. (a) Nipple to which the India-rubber tubing is attached; (b) the saliva tube.

Mr. C. Stokes. It is as well to use with them some rolls of bibulous paper. Though useful, they are still open to improvement, it being found that they exclude the moisture easily from the lingual surface, but not quite so effectively from the buccal.

But of all the means at present in use for the exclusion of saliva the *rubber-dam* is by far the most perfect; a great deal of practice, however, is required before being able to quickly and accurately apply it to the mouth. In the choice of rubber several points have to be taken into consideration. Elasticity, extensibility, and freedom from smell are essential properties of good rubber. Of the various makes that known as the "Velvet Brand," manufactured by the Davidson Rubber Company, appears to be as serviceable as any. It is usually sold in strips, varying in width, and is put up in tin canisters, which preserve it from moisture and the action of the air. The medium thickness is the best for use.

For punching holes for the teeth various methods are in vogue; the first and simplest is to stretch the dam over the end of an excavator, and then to touch it a short distance from the extremity of the instrument with a penknife, when a small round disc will fly off, a little practice will soon enable an operator to control the size of the perforation. Another method is to fold a piece of rubber into four, so that the point of folding coincides with the position of the required perforation, and to cut off the corner with a small pair of scissors. By this means a hole is cut which, although not truly circular, is very useful for all practical purposes. Lastly, perforations may be made with punches specially manufactured for the purpose; this method is by far the most perfect.

In applying the rubber dam to back teeth a little trouble is at first experienced in gauging the correct position to punch the hole. This difficulty may be readily overcome by placing the rubber into the mouth, and marking roughly where it comes over the teeth you wish to encircle. With molars the holes should be about $\frac{3}{8}$ inch in diameter and $\frac{3}{8}$ inch apart from one another, whilst with bicuspid and incisors they should be about $\frac{1}{8}$ inch in diameter and $\frac{1}{4}$ inch apart from one another. In dealing with simple crown cavities the rubber may be adapted to the single tooth, but with an approximal cavity the application must be extended to the tooth adjacent to the cavity. In apply-

ing the rubber dam it is most important to tuck it under the edge of the gum, firstly, as this prevents the rubber slipping; secondly, because it checks the saliva from dribbling down between the rubber and the tooth. The accompanying diagrams illustrate this point.

The drawings represent an antero-posterior section of a lateral incisor *in situ*. In figs. 185-187 is shown the method of tucking

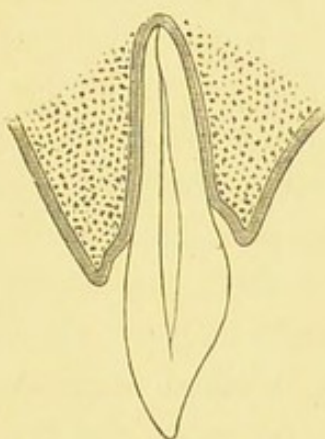


FIG. 185. Showing attachment of gum to tooth.

the rubber dam under the edge of the attachment of the gum to the neck of the tooth; in fig. 185 the way in which the rubber is applied when this precaution is not attended to, leading, as before stated, to the rubber slipping, and to the escape of saliva. Fig. 186, on the other hand, represents the rubber as applied to

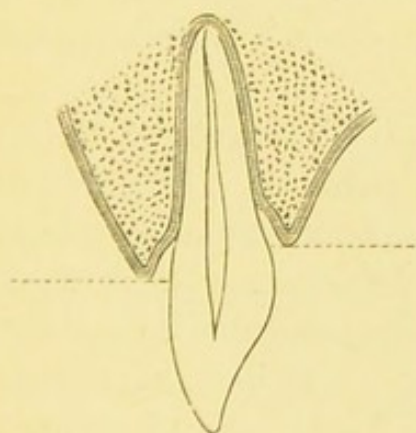


FIG. 186. Showing position of rubber dam when not tucked under the edge of the gum.

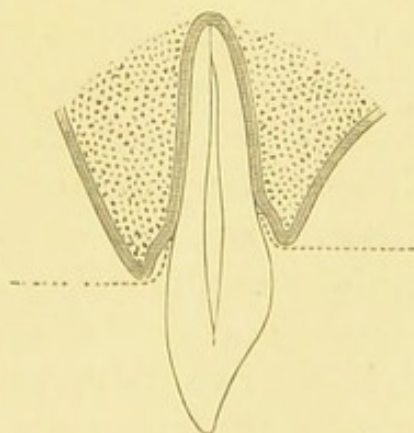


FIG. 187. Showing position of rubber when tucked under the edge of the gum.

the tooth when this has been attended to. To accomplish this a blunt instrument, such as a burnisher, must be used, or the silk must be passed between the teeth. The former is sometimes quite sufficient, but generally the latter has to be employed.

Clamps are useful for assisting to keep the rubber in place. Of these there is an endless variety, the most generally useful being the "festooned" molar and bicuspid introduced by Dr. Tees, and the molar and bicuspid clamps designed by Delos Palmer. Dr. Palmer's clamps are admirably adapted for fitting the teeth, but they have one objection—the flanges are hardly broad enough to prevent the rubber slipping over them. To overcome this some with broader flanges have been introduced, and have been found to be a great advantage.

For erosion cavities the most useful are the Johnson Lever Clamp and that designed by Dr. St. George Elliott. For operating upon distal cavities in isolated teeth these will be found useful. A point of some importance in applying rubber to teeth having approximal cavities is this: to be sure that the cervical edge of the cavity is defined; should the gum have encroached at this point, it will be needful to drive or destroy it by means of a little "potassa cum calce" or "ethylate of sodium" applied on cotton wool, assisted by gentle pressure. Sharp edges are sometimes met with, and are a source of great inconvenience when passing the silk; these should be removed if possible before the application of the rubber is commenced. Lastly, when the tooth to be operated on is coated with tartar, this deposit should always be removed before using the rubber dam.

(1) *Application of rubber dam to front teeth.*—This can be accomplished in the following manner:—Take a piece of rubber of the necessary size and pierce the number of holes required, taking special precaution to have the space above recommended between them. As a general rule, it will be found advisable to include at least three teeth under the rubber. Holding the rubber between the fingers and thumbs of both hands, stretch it over the required teeth, commencing at one end and passing it over the remainder in order.

Should the teeth be placed close together, a little difficulty may be experienced in passing the rubber between them. This may be best overcome by drawing a strand of silk between the teeth, which will carry the rubber dam before it. This operation completed, apply the retractors; and should the rubber not lie easily over the lower lip, attach weights to either corner.

The next step is to pass the silk in order to "tuck the dam under the edge of gum," as before explained. An easy, quick, and effective method of doing this is as follows, and a reference to the accompanying diagrams will greatly assist in following the description.

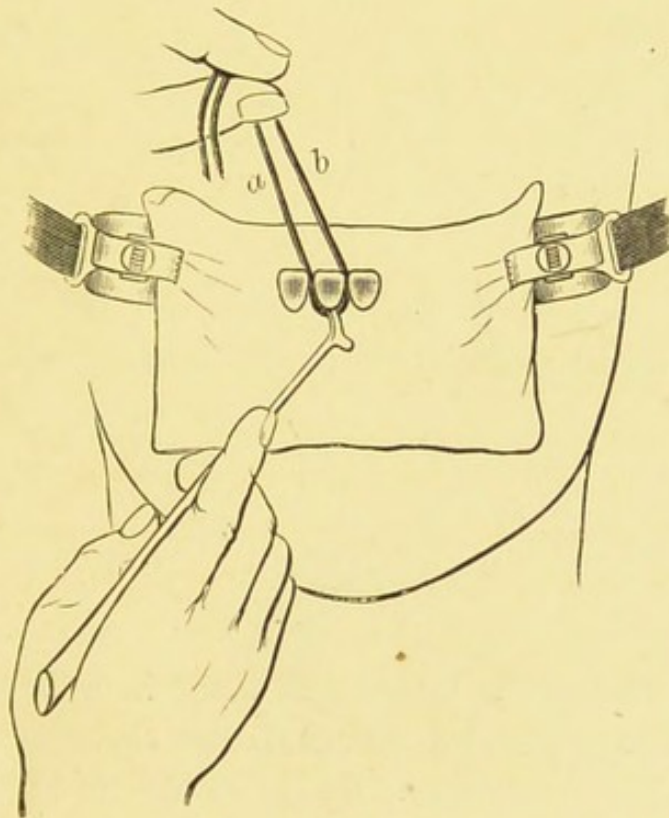


FIG. 188.

It is supposed that there is a cavity on the distal side of the left central. First, take the silk between the thumb and first finger of the right hand and the thumb and first finger of the left, and pass it up between the centrals, leaving it there; repeat the same on the side approximal to the lateral, having the free ends of silk in front and the loop behind. Next take the free

ends between the thumb and first finger of the left hand and draw them well forward; at the same time, by means of a burnisher, guide the loop up behind the free edge of enamel, still pulling the ends well forward (fig. 188).

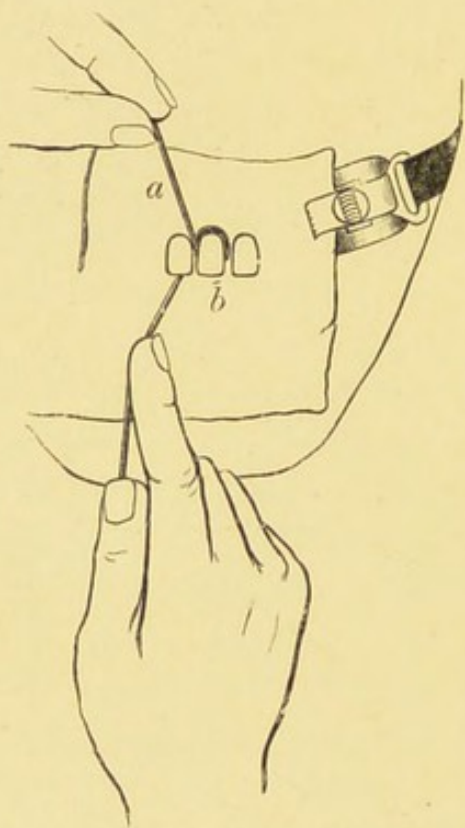


FIG.

Next hold the end *a* in the left hand in a direction slightly upwards and pass the end *b* over it, and then, still holding *a* as described, bring *b* between the centrals, using traction in a direction downwards and backwards (fig. 189). Then either cut the ends off short and leave the silk in position or remove it altogether. The former is preferable, this proceeding, viz., passing the silk, being carried out on every tooth over which the rubber is stretched.

In some cases, especially of conical teeth, the above method is not always sufficient to prevent the rubber from slipping. This may sometimes be overcome by passing the end *b* as directed

over *a*, then bringing it up again between the central and lateral, and over *a* once more; then applying traction as before directed. By this means you get a double strand of silk surrounding the tooth.

Another method of overcoming this tendency to slip is to apply an ordinary clove hitch. This is made as follows:—Fold the piece of waxed silk as shown in fig. 190, next simply pass, not fold, the loop *cd* in front of loop *ab* as shown in fig. 191,

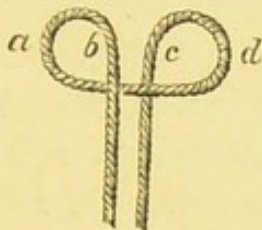


FIG. 190.

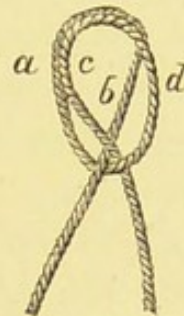


FIG. 191.

then apply to the tooth by taking the double loop well up behind the neck of the tooth, and exercising traction alternately on the ends (fig. 192).

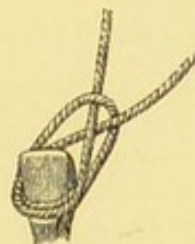


FIG. 192.

It is important that, in every case, the silk should be passed and the knot tied, or the twist made, on the side of the tooth away from the cavity, the reason being obvious.

(2) *Application to back teeth.*—In the application of the rubber dam to back teeth, it is generally necessary to use a clamp, and if the rubber is being applied to more than one tooth, the clamp should be always fixed on the most distal tooth. The use of a clamp prevents the cheek and tongue drawing off the rubber

when it is *in situ*, and affords a better view of the cavity. When using the clamp two methods are open to the operator:—

(a) The clamp may be applied, and the dam stretched over it, this method being handy where small clamps are being used. Or, (b), the clamp may be passed through the perforation in the rubber, and, having placed it in position on the tooth, the rubber may be gradually insinuated over its edges with the first fingers of either hand.

Having then by one of these methods adjusted the clamp, stretch the rubber over as many teeth as is necessary, using silk if requisite to pass it down the interstices. Apply the retractors, and carry silk round all the teeth, including the one on which the clamp is placed. This latter precaution is necessary, since the clamp does not cause the rubber to tuck under the gum, and hence, should the silk not be passed, a possible cause of leakage is left. The manœuvre is best effected in the following manner:—Place the silk behind the clamp, and bring the end which is towards the inside of the mouth under the palatal or lingual flange, as the case may be, and then pass it between the approximal surfaces of the teeth in front. Repeat

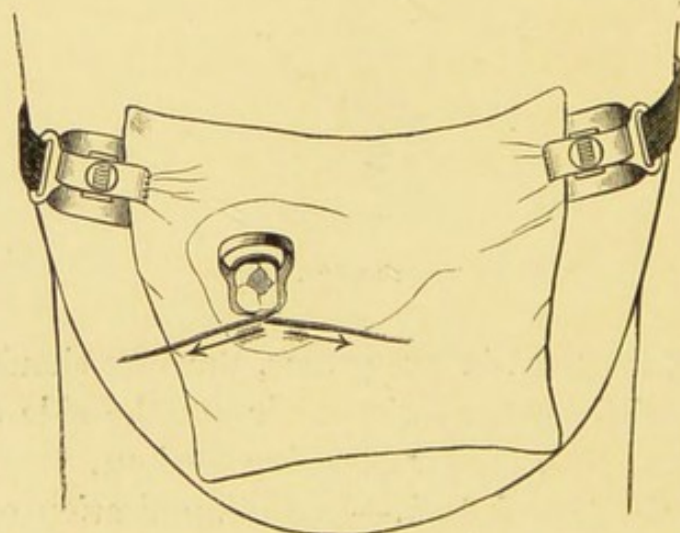


FIG. 193.

this operation with the other end by passing it under the buccal flange and also between the approximal surfaces. Now apply

traction to the end passing under the palatal or the lingual flange in an outward direction, and to that under the buccal in an inward direction. Fig. 193 illustrates this point. Then cut off the ends of the silk, or remove it altogether. In applying the silk to the remaining teeth, practically the same methods are employed as are adopted for front teeth.

Whenever the rubber is applied, it will always be found better to use the saliva pump in connection with it, the latter adding considerably to the comfort of the patient. It is also useful to place a napkin between the rubber and lower lip, carrying the ends upward underneath the vulcanite portions of the retractors, thus avoiding the temporary mark which they occasionally leave on the patient's face.

A caution as to the removal of the rubber is necessary, and it is this:—To be perfectly sure in every case that the silk ligatures are not left behind; for, if they are, inflammation, sometimes of a very troublesome character, results. It is well, therefore, to make a rule to take off the ligatures first, then the rubber, and always, after removing the latter, to look at the holes and see that they are perfect; for a ring of rubber has been known to tear away and remain on the tooth, and this has set up trouble similar to that caused by an elastic band.

(2) **The methods of separating teeth.**—The main objects in separating teeth are to give space for the free use of instruments, whether for filling or examination purposes, and to allow the restoration of the contour of the tooth in filling.

Separation can be effected by either removing a portion of the tooth, or by wedging the teeth apart by various materials or instruments. In young subjects the separation of teeth can be accomplished with a certain degree of safety. In the old, such is not the case, the result of wedging sometimes being to produce periostitis, leading to premature loss of the teeth. One author relates a case where the inflammation of the alveolo-dental membrane caused by the separator spread to the pulp, leading to its destruction. Careful consideration should be made before separating teeth in a patient over forty, and our judgment should

be guided by the condition of the patient's teeth, especially any tendency to pyorrhœa alveolaris, and by the presence of any constitutional condition where repair is not easily accomplished.

In considering the methods of separating teeth they may be roughly divided into the "gradual" and the "immediate." For the gradual method tape or rubber is generally used, commencing with narrow breadths, and gradually increasing the number till the required space is obtained. It is useful when the space is obtained to let one or two days elapse before operating, as this will allow the tenderness caused by the wedging to subside to a certain extent; and also, when instructing our patient how to use the tape, to prescribe a little of the tinctures of iodine and aconite, to be applied to the gum over the teeth that are being separated, as this will lessen the tenderness. Of the above (tape and rubber), the former is in most cases preferable. The disadvantages of the rubber lie in the fact that it works too rapidly, and causes a greater amount of inflammation. When, however, the teeth are very close together, it is sometimes impossible to get a strand of tape up, the rubber is then very useful for commencing the separation.

Wood for wedging can be used in exactly the same way as tape, viz., commencing with thin pieces and gradually increasing the thickness. The disadvantage of wood over tape and rubber is that the operator has nearly always to change the thicknesses of the wood himself, whereas the patient is himself able to apply the tape.

There are many who prefer to wedge with cotton, asserting that its action is just as effective as other methods, and occasions not the slightest inflammation. It is best used as follows:—Take a tuft of cotton and pull it into pieces, so that the fibres are parallel to one another. Next reduce one end to a thread by twisting it between the fingers and thumb; pass this between the teeth to be separated, and draw it forward with a pair of tweezers. This gradually separates the teeth with a power which has scarcely any limit, and must be exercised with discretion, the point at which to stop being when there is a

feeling of discomfort. The ends of the cotton tuft are then cut off pretty close to the enamel, and the saliva moistening the cotton causes it to separate the teeth.

Another extremely useful way of separating teeth, especially back ones, is at the first sitting to prepare the cavity roughly, and fill the space up with some gutta percha, bringing it against the side of the adjacent tooth. The gutta percha should be inserted in a not very soft condition, being forcibly wedged up with a cold burnisher. The saliva causes the gutta percha to swell, and so separates the teeth. The cheaper forms are the best, since there is a greater tendency for them to swell. After wedging by the gradual method, the teeth are often found very tender. When this is the case, the operation of filling should not be undertaken, but the space should be maintained until the tenderness has passed off by filling it up with some soft gutta percha.

Of immediate methods for separating teeth, that by means of wooden wedges is very simple. It is accomplished by cutting two narrow wedges of very fine grained wood, such as orange or box wood, and inserting them between the teeth, one at the neck and the other at the cutting edge. These are then alternately tapped with a mallet until enough separation is obtained. The wedge between the teeth at the cutting edge is then removed, and the other left *in situ*. Another method of inserting wooden wedges is with special forceps made for the purpose, one blade conveying the wedge, the other a pad of rubber to protect the enamel from injury during the operation of introducing the wedge.

Of the special instruments made for separating teeth Perry's and Parr's are probably the best known in this country. Quite recently, however, Mr. Blandy has introduced a separator which consists practically of a pair of wedges, one of which is placed between the teeth in front and the other behind, and the separation brought about by approximating them by means of a screw.

There can be no doubt of the practical utility of this class of instrument in certain cases. It enables the operator to complete the filling at one visit, and, with the exception of gutta percha,

is the least painful method of separating teeth ; but gutta percha has the disadvantage of being slow in its action. A disadvantage of all of these contrivances is that they are to a certain extent a hindrance to the use of our filling instruments, and, in the case of the one introduced by Mr. Blandy, the very act of application causes at times severe bruising and friction of the enamel.

Whenever applying these screw separators, the instrument should be kept firmly in position with the left hand, and the turns of the screw not made too quickly. A disadvantage one often meets with in Perry's is a tendency for the instrument to slip towards the gum. This can easily be overcome by placing under the bows small pieces of either gutta percha, rubber, or lead, just as turning the screws is commenced. Of the above-mentioned separators, Perry's is certainly the best, and it is advisable to have at least six sizes for the different teeth. Parr's separator seems to be more universal in its use, but is certainly more clumsy. Blandy's can be applied more quickly than either of the preceding, but its use is attended with far more discomfort.

It will be found best as a rule to commence separation by one of the gradual methods, completing with one of the immediate, and it should never be lost sight of that, when filling after wedging, the main way to avoid pain is to keep the teeth perfectly steady.

(3) **The preparation of cavities.**—Success in filling depends largely upon having the cavities carefully prepared. We shall consider this portion of the subject under three headings,—The preparation of cavities (*a*) in general, (*b*) for gold fillings, (*c*) for plastic fillings.

(*a*) *Preparation of cavities in general.*—In the preparation of all cavities certain general points must be noticed. One of the most important of these is the necessity of using sharp excavators, enamel chisels and burs, for by their use not only can the work be done better and more quickly, but the pain of the operation is lessened. If it is intended to use the rubber dam, it should in small cavities be applied before commencing. When, however, the cavity is large or contains much soft material, it is better to

roughly clear out the decayed tissue before applying the rubber dam; frequent syringing in such cases is of great value. The advantages of using the rubber are these: the work can be done more quickly, the tooth cut in a dry state preventing the burs getting clogged; and lastly, both hands are free.

It is always better to prepare cavities on some definite system, and the following is recommended:—

First, open the cavity up freely by means of burs and enamel chisels, getting rid of all overhanging edges of enamel, etc.; next clear out all softened and decayed dentine as far as possible with sharp excavators; and thirdly, shape the cavity to the form required for holding the filling. With regard to opening up the cavity, the most important point is the avoidance of overhanging edges of enamel; they are a source of failure, and too much cannot be said on this point. It should be an almost constant rule to take away any enamel unsupported by dentine (the exceptions, perhaps, being in those few places where the enamel is not subjected to direct pressure, as, for instance, on the labial surfaces of front teeth). The reason is obvious: enamel is brittle, dentine elastic, and unless the enamel has something to counteract the strain it will fracture. In removing the softened dentine, the instruments should be used very sharp and decided cuts into the tissue made, avoiding anything like scraping, as it is extremely uncomfortable to the patient.

(b) *The preparation of cavities for gold fillings.*—Shaping the cavity is a most important step, and may be safely divided into two distinct stages—(1) obtaining a form which will retain the filling, and (2) trimming and paring the edges. To achieve the former, the cavity should be so shaped that all parts are easily accessible, deep undercuts and receding angles being avoided. This is of great importance with cohesive gold, when each separate piece has to be taken to the place it is intended to occupy, for if there are inaccessible undercuts the result is that that portion of the cavity is insufficiently filled. The edges require great care in finishing, for on them depends, to a large extent, the durability of the filling with cohesive gold.

The best results are certainly obtained by slightly bevelling the edges, leaving them neither straight nor yet undercut. If you have the edge much undercut, there will be a few enamel fibres left unsupported by dentine (since the fibres always run in a direction toward the pulp), and the result will be that with improper pressure they will give way, forming a vulnerable point in the filling (fig. 194, *a*); if, however, they are left but slightly bevelled, all the enamel is supported by dentine, and failure is prevented (fig. 194, *b*). The best instruments for carrying out



FIG. 194.

this part of the work will be found to be enamel chisels for sides of proximal cavities, small spoons for the cervical edges, and fine-cut cavity burs for the crown surfaces.

Passing on from the edges, starting-points certainly deserve a little attention, and to be successful this part of the operation should be divided into two distinct steps, viz., burying the drill to such a depth that the head is just below the level of that part of the cavity where the point is being made, and then moving the head with a slight rotary motion; if this is carried out, the effect is a small cavity (fig. 195). Now, should the drill-head only be buried half way, and then the rotary motion made, the effect will be a cup-shaped cavity, which is useless (fig. 196). Further, starting-points should always be drilled in dentine, and not at the junction of the enamel and dentine; for, if drilled in the latter place, one wall of the starting-point is formed by enamel, and the

effect is fracture during filling. The direction of starting-points should be as far as possible away from the pulp.



FIG. 195.

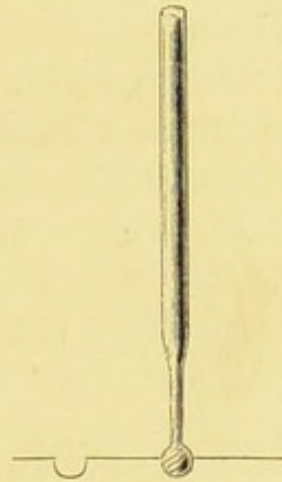


FIG. 196.

Another consideration in preparing and shaping proximate cavities is the relation of the tooth to its neighbour. All joints should be made as accessible as possible to the tongue and tooth-



FIG. 197. Diagram showing cavities prepared in such a way that the junction between the filling and enamel cannot easily be kept clean.



FIG. 198. Diagram showing cavities prepared in such a way that the joint between the filling and enamel can be easily kept clean.

brush, so that food, etc., may be prevented as far as possible from lodging near them. To ensure this, the tooth should be always cut back, so that, when filled and allowed to close, the fillings only are in contact with the adjoining tooth, and not the enamel of one with the enamel of the other.

The simplest form of cavity is that having four walls, and good examples of this are the cavities occurring upon the crowns of molars and bicuspid. To shape these, the walls should be made slightly out of the perpendicular, the floor being left flat, and the edges trimmed as directed. Starting-points should be avoided, as there is a great danger, in drilling them, of injuring

the pulp. Fissure, oval, and inverted cone-shaped burs will be found amongst the most serviceable for use in this class of cavity.

Many patients present themselves with carious lower molars, the caries only showing itself in the fissures, and a quick method of preparing such cavities is to proceed as follows:— With a fissure bur cut through all the fissures, as shown in fig. 200; then, with enamel chisels, break down the triangular



Fig. 199. Diagram representing carious lower molar.



FIG. 200. Diagram showing all the fissures cut through, the dotted lines marking off the portions to be cut down with enamel chisel.



FIG. 201. Diagram showing cavity after the use of enamel chisel.

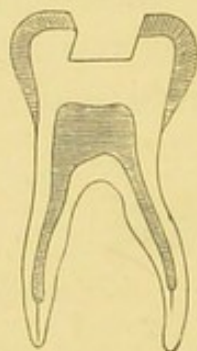


FIG. 202.

portions of enamel thus left; the dentine is then cleared out, and the walls can be quickly shaped with suitable burs.

With cohesive gold in lower molars, it is often found that if the anterior wall is undercut, or even quite perpendicular, it is extremely troublesome to fill. To overcome this, that wall should be quite sloping (fig. 202), and then it can be easily seen and properly filled, the filling being held in by making the buccal and lingual walls of the cavity diverge a little posteriorly.

Another form of cavity is that usually seen upon the approximal surfaces of bicuspid and molars. These cavities generally start near the gum margin, and if the crown of the tooth is not

already involved, it is necessary to cut through it in order to get to the cavity. In such cavities it will be seen that there are two directions in which we have to prevent the filling coming out: the one from above downward, the other laterally. To prevent this, two ways are open to the operator: the one by cutting the labial and lingual walls so that they diverge not only in a direction toward the cervical edge, but also toward the axial portion of the tooth, the shaped cavity made being a double wedge; the other by making two lateral grooves, which diverge slightly as they proceed upward—the one method frequently merging into the other. The cervical edge in these cavities should be left quite flat, and the edge of enamel bevelled off slightly; however, should the cervical edge be near the termination of the enamel, it is then best to remove all the remaining enamel, and allow the edge to be formed by dentine alone; a thin edge of enamel is pretty sure to fracture and chip off in filling. Should any fissure exhibit itself on the grinding surface, it must be cut out; if this is done, it will form an additional hold for the filling; if left, it is a nucleus for fresh trouble. Anchorage in these cavities is obtained by making two starting-points, one in the cervico-lingual and one in the cervico-labial angle, great care at the same time being taken that they are drilled in dentine, and not at the junction of the enamel and dentine. A useful mode of procedure in preparing these cavities is as follows:—With a small fissure bur connect the cavity with the crown surface, taking the cut well back, as shown in fig. 204.

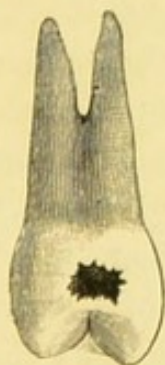


FIG. 203.



FIG. 204.

Then with enamel chisels break down the triangular portions of tooth substance thus left, and clear out the decayed tissue. The cavity will then be somewhat cup-shaped (fig. 205).

Next, a fine fissure bur should be taken, and two grooves made in such a manner that they diverge as they approach towards the cervical margin, the cavity at this stage appearing somewhat like fig. 206. Now with an enamel chisel the portion as dotted in fig. 207 is cut down, so that the cavity will be a



FIG. 205.



FIG. 206.

double wedge. When the cavity is situate near the gum, instead of opening up through the crown, it is well, by cutting through the outer or labial wall, to shape the cavity in exactly the same way as usual, except that the lingual wall will then form the base of the cavity. This method of treating approximal cavities has the advantage of leaving the crown surface intact, and is especially useful in cavities occurring upon the posterior surface of lower bicuspid, more particularly when the latter are tilted, as under such conditions the cavity is more accessible.

Caries in front teeth generally takes place upon the approximal surfaces, involving frequently both lingual and labial walls to a greater or less extent. The smallest cavities are often the most difficult to fill. If the filling to be used is non-cohesive, the walls of the cavity should be shaped similarly to ordinary crown cavities; but if cohesive gold is used, it will be found difficult to fill against the anterior wall under such conditions. It is as well to prepare them as follows:—With a fine finishing bur the anterior wall is cut

so that it slopes outwards and can be easily seen, a starting-point being made at the cervical margin and an opposing point below for retention of the filling.

Another method of treating these cavities is to open them up from the lingual wall, saving as much as possible of the labial. The shaping of the cavity will then be somewhat like that of approximal cavities in bicuspids and molars, retention being obtained by slightly grooving the cervical edge and employing two good retaining points, these being opposed by a small groove or opposing point according to the amount of tissue present at that part of the cavity (fig. 208).



FIG. 207. Represents an approximal cavity in a lower bicuspid opened up through the labial wall.



FIG. 208.

When the cavity involves the side of the tooth to a large extent, the labial and lingual walls must both be freed from all frail enamel, and a different mode of procedure adopted in shaping it. If there is enough dentine, the labial and lingual walls should be grooved, the cervical wall being left so that the portion towards the axial part of the tooth is on a higher level than the approximal portion. At both the cervico-labial and cervico-lingual angles starting points should be drilled, and these opposed by a good-sized pit drilled towards the apex of the cavity (figs. 209 and 210).

(c) *The preparation of cavities for plastic fillings.*—For amalgam the preparation of the cavity differs slightly from that required for gold. The principal points to pay attention to are:—(a)

To leave the edges straight and not bevelled, as the thin layer of enamel thus left is less liable to fracture than the thin ledge of amalgam which would be present if the edges were



FIG. 209. Longitudinal section of an approximal cavity in an upper incisor tooth.



FIG. 210. Transverse section of approximal cavity in an upper incisor tooth.

left bevelled off; (b) the walls of the cavity, according to Dr. Hogg, should be left round rather than straight, as this helps to efficiently meet the spheroidal tendency seen in amalgam.

In an article in the *Dental Cosmos*, July, 1884, Dr. Dodge, referring to the preparation of cavities for amalgam in relation to this spheroidal tendency, suggests that they should be prepared in such a way that the depth of the cavity is always greater than the width, and the grounds for suggesting this are as follows:—When an irregular mass tends to assume the spherical form, every point of the surface which is most distant from the geometrical centre of the mass, the radius of a sphere of equal bulk, will move towards the centre, and every point less distant will move from the centre; in other words, all long diameters shorten, short ones lengthen. Fig. 211 represents the shape that a square mass would thus undergo—diameter BD shortening and EF lengthening. If a mass of the same shape be surrounded by a resisting material, such as the walls of a cavity, the effect of contraction will be to bring the diameter EF closer to the walls of the cavity, while at the same time the

diameter H will also expand (fig. 212); but, should the mass or cavity be shaped like fig. 213, the contraction will tend to shorten the longer diameter, and so bring it away from the

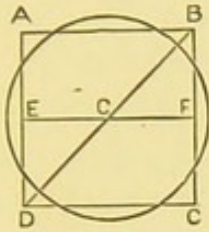


FIG. 211.

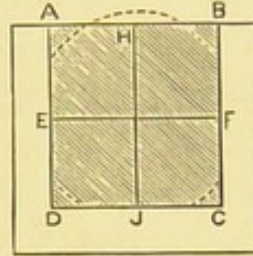


FIG. 212.

walls of the cavity. Supposing the shape to be similar to fig. 214, then the contraction of HJ which will take place will tend to draw the projecting piece AB tighter to the walls of the cavity.

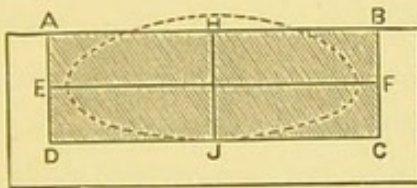


FIG. 213.

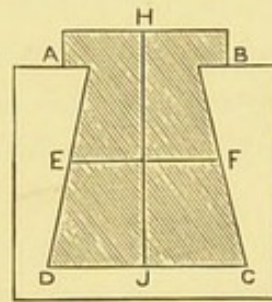


FIG. 214.

On the same grounds Dr. Dodge maintains, if a cavity of shape shown in fig. 215 is filled simply flush with the margin, the portion DCB being filled with oxy-phosphate, the contraction

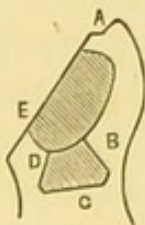


FIG. 215

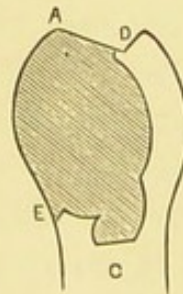


FIG. 216.

will cause the mass to move away from the margins of the cavity; but if filled similar to fig. 216, entirely with amalgam,

the contraction of the long diameter will cause the filling to become tightly pressed against the margins.

Dr. Dodge's suggestions are certainly interesting, and are well worthy of consideration, and to a certain extent are supported by experience of amalgam fillings in practice.

Cavities for osteoplastics and gutta percha call for no special mention, and they should be prepared on much the same principle as others. There is no necessity to make the walls straight, and it is not requisite that all parts of the cavity should be easily accessible, since the fillings, being plastic, can easily be pressed into position.

(4) **Treatment of sensitive dentine.**—In connection with the preparation of cavities sensitive dentine is often met with, and some parts of a cavity will be found extremely sensitive, while other portions are practically painless. The portion of dentine immediately beneath the enamel is at times very sensitive, and the same may be said of the superficial layer of carious dentine. In all cases of sensitive teeth care must be taken to discriminate that condition from the nervousness of the patient. Much can be done to allay sensitiveness by keeping the cavity quite dry and using sharp excavators and burs. An occasional blast of warm air from the hot-air syringe will often assist in relieving the pain. It will sometimes be found that cutting in one direction will give rise to pain, in another not. Occasionally relief may be gained by swabbing out the cavity with carbolic acid, strong phosphoric acid, or allowing a little zinc chloride to dissolve in it. In cases where it is intended to use metal fillings, and the dentine is sensitive, it is better to insert an oxy-phosphate filling, allowing it to remain for about six months. In some cases it will be nearly impossible to remove any tissue at all from the cavity under such conditions. A filling of oxy-sulphate left for one or two weeks is very valuable. In back teeth a solution of nitrate of silver will be found useful, and is especially serviceable in erosion cavities occurring near the gum margin. Many other preparations have been from time to time advised. Equal parts of oil of cloves and

carbolic acid are said to remarkably decrease sensibility, and Mr. Coleman recommends a saturated solution of tannin in ether applied to the cavity on cotton-wool and changed two or three times daily. Dressings of carbolic acid sealed with cotton-wool and mastic or gutta percha may also be mentioned, as well as cocaine; but this latter is not so useful as generally supposed.

(5) **Use of matrices.**—The matrix is a very useful adjunct in filling, especially with approximal cavities, as by its use one practically converts the cavity into one with four walls. The simplest form of matrix is a piece of “clock spring” or “dividing file” bent to the shape of the tooth, and firmly wedged into position. A very serviceable set of matrices are those known as the Herbst, while Jack’s and the Ladmore-Brunton are also much used; but individual operators prefer different varieties. Whenever used, matrices must be firmly kept in position, and should fit accurately against the cervical margin. Plastics can easily be used, but with gold much care must be taken to see that the metal is brought over the edges. It is extremely difficult to use matrices in connection with cohesive gold, and it is better to employ non-cohesive at the upper part of the cavity, as this can be more easily worked and adapted to the cervical margin. If Perry separators are being used, the matrix can be held *in situ* by the claws of that instrument. With amalgam fillings which have been built out to contour, great care must be exercised in removing the matrix, and generally it is better to allow the matrix to remain until the filling has hardened.

In teeth where there is great loss of tissue, circular matrices will be found of service, as by their aid the contour of the tooth can be restored. In broken down teeth, where it is difficult to obtain anything like a properly shaped cavity, screw posts placed in the pulp canals or screwed into the dentine, if the pulp be not dead, will enable the operator, with the aid of a matrix, to insert a serviceable filling.

(6) **The materials used for filling teeth, and their relative value.**—For filling teeth various materials are used, *i.e.* gold, tin, amalgam, osteoplastic compounds, gutta percha, while solutions of gum

resins are employed in conjunction with cotton-wool as temporary fillings. The qualities of the ideal filling are that it shall not only be hard enough to resist attrition, but shall also withstand any chemical action in the mouth. It should be a non-irritant and non-conductor, be easy of adaptation, when inserted should retain its shape and form, and, lastly, the colour should resemble that of the natural tooth. At present none of the fillings in general use individually fulfil all these conditions. A careful selection of the material has therefore to be made in any given case.

Gold.—Under suitable conditions, to be referred to subsequently, gold forms the best filling at present possessed. It is used in two distinct modifications, viz., the cohesive and the non-cohesive preparations. Two kinds of gold are sold, the difference between them being brought about by a slight alteration in their manufacture. In the cohesive method each piece of gold is made to cohere to that already in place, and should not move in the slightest degree after it has once touched the filling. In the non-cohesive method the portions of the filling are held together by being intimately interlaced and wedged against each other, and this can only be obtained by the several portions sliding readily over one another, and therefore any approach to adhesiveness causes the filling to contain hollow places. Each method has its special advocates, those for the non-cohesive claiming that it adapts itself better to the walls of the cavity than the cohesive, and that it is quicker to work; while for cohesive gold it is asserted that, though taking longer to work, it makes a harder filling, adapts itself equally as well to the walls of the cavity (provided this is properly prepared), and has the advantage of being able to withstand any leverage which may come into play. A combination of the two methods is extremely useful.

Gold should be employed as a filling when the teeth are of fair structure, and especially in cavities in front teeth. It should not be used in the teeth of children, but it is difficult to say at what age one can insert gold, much depending upon circumstances. As a general rule, it should not be used before the fifteenth year. Its use is contra-indicated in teeth the structure of which is weak, the

osteoplastics and amalgams, with all their disadvantages, being found in such cases more suitable. In patients of highly nervous temperament or in a low condition of health the insertion of a large gold filling is undesirable. Of the two forms it may be said that non-cohesive is indicated in crown cavities, and the upper part of approximal cavities in molars, bicuspid, and front teeth, cohesive being used when any contour is required or any strain likely to be thrown upon the filling.

The advantages of gold as a filling are (1) that it does not alter its shape, and therefore forms a practically water-tight plug; (2) that it withstands attrition: but in using gold it should be remembered that it has no preservative action whatever upon the tooth substance.

Tin.—Tin is very little employed as a filling by itself, being generally used in combination with gold. The advantages claimed for it are that (1) it is easy to work; (2) it has a preservative action upon the tooth substance. For the latter reason it is generally used as a lining to cavities and at cervical margins. It has one distinct disadvantage in the fact that it becomes black.

Plastic fillings—Amalgam.—An amalgam may be defined as an alloy, of which mercury is an ingredient, the combination being with one or more metals—varieties of amalgam containing different metals in varying proportions. As each metal materially affects the character of the amalgam of which it forms a part, it will be better at the outset to briefly discuss the individual effects.

Silver is found in a large number of amalgams. The advantages of it are that it increases the hardness and lessens the contraction, it being found that a simple alloy of mercury and silver expands on cooling. The disadvantage of silver is that it discolours not only the filling but also the tooth, a result due, it is said, to the formation of sulphide of silver, which is formed through the silver coming in contact with sulphuretted hydrogen in the mouth. Tin prevents discoloration and reduces the conduction of an amalgam; but it causes slow setting, loss of edge strength, and leads to extensive shrinkage.

Copper is said to diminish shrinking, to hasten setting, and to

give the filling tonic and therapeutic properties. A disadvantage it possesses is discoloration. Sullivan's amalgam, which is much used, is a combination of three parts of copper with six to seven of mercury. The copper used is obtained by precipitating it upon zinc rods from a weak solution of sulphate of copper, and then washing the precipitate in strong sulphuric acid.

Gold present in amalgams causes them to work more easily and in a cleaner way, reduces the shrinkage, produces good edge strength, and assists the filling to maintain a good colour.

Platinum assists the setting and increases the hardness after setting.

Palladium forms with mercury a most useful filling. It expands slightly on cooling and so forms a perfectly water-tight filling. It discolours, turning quite black, but does not lead to any staining of the tooth substance. It is probable that in combination of the two metals chemical union takes place, as much heat is evolved in mixing, leading in some instances to explosion.

As a filling it is difficult to compare amalgam with gold. In cavities in teeth of strong or even medium structure which are of easy or moderately easy access, gold is infinitely preferable; but amalgam is indicated in preference to gold in (1) cavities and broken down teeth where the walls are frail; (2) in large cavities occurring in the teeth of those who are unable to bear the strain of a prolonged operation; (3) in cavities in teeth of weak structure; (4) in cavities at the back of the mouth or in positions difficult to get at; (5) in the teeth of children. It should not, as a rule, be used in front teeth, with the exception of the distal surface of the canine.

The advantages of amalgam are that it can be inserted more quickly and more easily than gold, and that many varieties have a distinctly preservative action upon the tooth substance. Its disadvantages are its (1) liability to become discoloured; (2) tendency to alter in shape. Both these drawbacks to its use may to a certain amount be overcome by (a) careful attention to the composition of the alloy used; (b) attention to the preparation of the cavity; (c) the method of inserting the filling.

Some amalgams, in addition to turning darker themselves, also cause discoloration of the tooth substance by direct staining, and it is curious to note that under such conditions the amalgam seems to have great preservative powers.

The alteration in shape is due to the tendency of amalgam to assume a spheroidal form, this change commencing when the hardening is completed and continuing even for months.

Mr. Kirby has made some interesting and valuable experiments in connection with this tendency to alter in shape, and for carrying out his investigations constructed an apparatus consisting of a metal trough with a screw micrometer—the trough being filled with amalgam of various consistence (fig. 217).

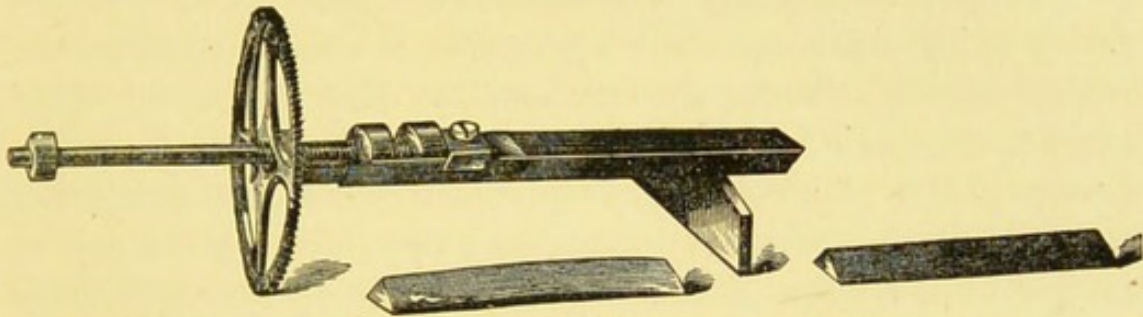


FIG. 217.

When he employed the amalgam in the way generally adopted for filling teeth—viz., by making one mix and gradually filling the cavity, taking off excess of mercury—he found that the bar turned up at the ends, the alteration commencing a few hours after filling, and increasing very much within the next two or three days. In his experiments a large number of amalgams were used in different degrees of consistence, it being found that when he filled the trough with amalgam of soft consistence in the lower part, and in a drier condition in the upper portion, the bending could be prevented. Mr. Kirby also found that the mercury apparently passed from one portion of the mass to the other, going from the softer to the drier, and causing contraction in the former and expansion in the latter. In one bar, divided a day or two after being made, and into two in such a way that each was of similar weight, he found that there was an excess

of mercury in one over the other. When he examined similar bars after a period of one or two months the mercury was found to be equally distributed. As the result of his experiments, he is of opinion that the spheroidal tendency of amalgam is due to unequal distribution of mercury throughout the mass, and that the alteration is produced by the passage of the mercury from one part of the filling to the other, causing contraction in the portion containing excess and expansion in the drier. When the mercury is distributed equally throughout the filling no change in shape takes place, since there will not be any passage of mercury from one place to another. The usual methods of inserting fillings lead to the first condition—viz., unequal distribution of mercury—the lower portion of the cavity being drier than the upper, the mercury rising to the surface through the manipulation of it. If, however, the lower portion is put in soft and the top quite dry, there is a much greater chance of obtaining an equal distribution of mercury and so avoiding the shrinkage. It appears, therefore, that something may be done to cope with this spheroidal tendency by the mode of insertion. We may also counteract it to a certain extent by the judicious combination of the various ingredients.

Osteoplastics.—The osteoplastics are a most valuable class of filling materials. Three varieties are used, viz., oxy-chlorides, oxy-phosphates, and oxy-sulphates.

In oxy-chlorides the powder is zinc oxide which has been heated to almost whiteness for about two hours, during which it loses nearly half its original bulk. The fluid is a solution of chloride of zinc. Each special preparation naturally differs a little in detail of manufacture. As a filling oxy-chloride is valueless for permanency, being easily acted upon by fluids of the mouth, especially at cervical edges. In places where there is much attrition it is also of but little use. It is hygroscopic, sets slowly, is an irritant, and an antiseptic. If used at all, it is principally employed as a root filling or for insertion as a filling for allaying sensitive dentine; but in such cases there must be a good layer of dentine between it and the pulp, for if

this is not the case the pulp may become irritated, and eventually die.

In oxy-phosphates the powder is oxide of zinc. The fluid consists of one of the varieties of phosphoric acid ; but, like the oxy-chloride, the different varieties differ only in minor details of manufacture. As a filling it is more permanent than the oxy-chloride. It is soluble in the alkaline secretion of the mouth. It is antiseptic, though not so strongly as the chloride; but, like the latter, if used in too close proximity to the pulp, it leads to the death of that organ. The period of duration of an oxy-phosphate differs, averaging about two years, though some last for seven years, and, in rare instances, longer. Strict cleanliness of the mouth and application in proper cavities assist the permanence. Its use is indicated (1) as a flooring in crown cavities (when not too near the pulp); (2) as a root filling (to be subsequently described); (3) as a lining to cavities with frail walls; (4) in the teeth of children; (5) in cavities which are sensitive, and in which it is desired to put a metal filling; an oxy-phosphate inserted in such, and allowed to remain for a period of three to six months, will act as an obtundent; (6) in front teeth of weak structure in which gold is contra-indicated. It should not be used in cavities which are freely bathed in saliva, and it is therefore worse than useless at the cervical margin.

In oxy-sulphate the powder is composed of a mixture of calcined sulphate of zinc and oxide of zinc. The fluid is a solution of gum arabic. Oxy-sulphate is extremely useful (1) as a flooring to sensitive cavities when near the pulp; (2) combined with oil of cloves, it makes an excellent material for covering exposed nerves; (3) in cavities where the dentine is too sensitive to remove, a filling of oxy-sulphate used for one or two weeks will considerably allay the sensitiveness.

In connection with osteoplastics, it seems probable that in the future they will be used extensively in connection with amalgam or for attaching the first piece of gold in starting cohesive gold fillings. The method of using these combinations will be subsequently described.

Gutta percha.—Gutta percha is the inspissated juice of the isonandra gutta and other trees of the natural order Sapotaceæ. It is insoluble in alcohol, but soluble in ether, chloroform, and carbon bisulphide, and for dental purposes is generally admixed with zinc oxide and sulphide, calcium carbonate and aluminium. It is generally supplied in two forms, viz., temporary and permanent. The former, a good variety of which is Gilbert's, softens at a low temperature, is easily applied and removed, and therefore makes a good filling for holding in various forms of dressing. Of the permanent varieties, Jacob's is the best. Red "base plate" is used by many in preference to any other form of gutta percha, being harder and bearing attrition better.

As a filling, gutta percha is a perfect non-conductor; and though it does not make a water-tight filling, fresh decay seldom occurs from this cause. In dirty mouths it discolours, becoming yellowish in appearance. If inserted too near the pulp, it frequently leads to the destruction of that organ, and also appears to increase the sensitiveness of the dentine, for cavities in which gutta percha is temporarily placed always appear more sensitive on the removal of that material than before its insertion.

Gutta percha should not be used upon a masticating surface, as it bears attrition badly, though to a great extent it withstands moisture and the chemical action of the saliva. Gutta percha, though principally used as a temporary filling, is occasionally of great use permanently, the principal cases in which its use is indicated being—(1) the front teeth of young children, as the saliva in such cases seems to dissolve osteoplastics away very quickly; (2) in some approximal cavities in children; (3) in those cavities around teeth where the decay has been brought about by bands; (4) in cavities on the buccal surfaces of molars; (5) at the cervical margin of cavities, the remainder of which are filled with osteo; (6) for filling root canals; (7) as a temporary filling in cases where it is requisite to wedge the teeth (see Separation of Teeth).

Solutions of various resins—gum mastic and gum sandarach—are used as temporary fillings; these, hardened by the resin,

being precipitated by the saliva, and the ether or chloroform, etc., evaporating.

(7) **Introduction of filling materials.**—(a) *Gold.*—This subject will be considered under four headings, viz.—

- (i.) The method of using cohesive gold.
- (ii.) The method of using non-cohesive gold.
- (iii.) Combination of i. and ii.
- (iv.) Gold in combination with other metals.

(i.) *The cohesive method.*—This method is more usually adopted than any other, and special instruments are employed in it for introducing and consolidating the gold. These consist principally of pluggers and mallets, and it will be found useful to briefly discuss their relative merits before passing on to the actual consideration of the introduction of the gold into the cavity. To consolidate gold, either hand pressure or mallet force is used; in the former, the force is given to the plugger direct from the hand of the operator; in the latter, by means of a blow struck by either a hand, automatic, pneumatic, engine, or electric mallet.

The *hand mallet*, the simplest of all mallets, is made of various materials, and in various shapes; the usual form consists of hard wood filled with lead, as this gives a dead, steady blow. This mallet is used either by the operator himself, or by an assistant; the blow delivered on the end of the plugger should have a sharp springing stroke. Many operators claim that the results obtained by the use of a hand mallet are better even than those obtained by the electric mallet.

Automatic mallets work by the action of a special spring, and some of the modern forms have a back action. Of this class of mallet the favourite forms in this country are those manufactured by Ash & Sons, and the Buffalo Dental Manufacturing Co. Of those possessing a back action, Abbot's is the one most generally employed. When in use, the automatic mallet should be held like a pen, with the end, if possible, resting on a finger of the left hand, thus giving the mallet a point of purchase. The plugger should also be raised a little distance from the

surface of the filling, so that each time a blow is delivered the plugger is practically thrust into the gold. Some place the plugger point on the filling, and then push the mallet, but a great amount of the force of the blow is thus lost. The automatic is a fairly serviceable form of mallet, but care should be taken to use pluggers, the action of which will be as far as possible in a direct line with the force of the blow.

In the *pneumatic mallet* the necessary force is obtained by pressing with the foot or hand on an air bulb. The handpiece can also be adapted to convey electric mallet pluggers. This instrument is used by placing the bulb on the floor, exerting the pressure with the sole of the foot. A very slight movement of the foot will be required, the blow being regulated by means of a sliding collar on the handpiece, and by the amount of pressure applied to the bulb. With this mallet several blows can be obtained in quick succession. The instrument is most useful for condensing retaining points, heavy foils, whether cohesive or non-cohesive, and for chipping down overhanging edges of enamel with a chisel. It is not therefore a mallet to be advised to those who limit themselves to the use of only one instrument.

Of *engine mallets*, Power's, St. George Elliot's, and Bonwill's are the forms generally used. With the Bonwill mallet the blow is struck by the action of a cam on a pulley driven by the engine, which, as it revolves, strikes upon the end of the plugger. All these mallets give a varying number of blows dependent upon the speed at which the engine is worked. The disadvantage is that the blow is frequently jerky, but, if used with care, they are certainly great helps in filling. Various mechanisms are used to control the blow, which is consequently to a great extent under the power of the operator. The method of using them is somewhat similar to that of the electric mallet, and will be referred to later on.

The *electric mallet* is the best instrument for condensing gold. The advantages claimed for this instrument are—(1) the blow is delivered upon the packing instrument just at the point where its force is greatest; (2) the force of the blow can at all times be

controlled by the operator; (3) it condenses the gold thoroughly and evenly throughout the filling; (4) gold can be impacted against thin frail walls with ease, and without fear of fracturing the enamel; (5) it saves time, and is less fatiguing in its use.

One of the greatest arguments brought against this mallet is that the battery is constantly getting out of order. This disadvantage has now been overcome by the introduction of accumulators which are stored so as to run for varying lengths of time. The size in general use runs for about 75 hours before requiring a recharge, which is soon effected at a very moderate cost. These accumulators are a great advance, and give the electric mallet a still greater charm. It is needless to say that everyone who uses the mallet should thoroughly understand its mechanism. Cohesive gold should always be used with it. The following description of the method of using the electric mallet is condensed from Marshall Webb's *Operative Dentistry*:—

“In commencing the filling one or two pieces of foil should be placed in the retaining point of the cavity with the instrument by hand; as each piece of gold is passed over the spirit lamp, and introduced into the cavity (either by an assistant with light pointed foil carriers, or by the operator himself with the packing instrument), and simply attached to the starting-point or to gold already in the cavity, the electro-magnetic mallet should be set in operation, and the finely serrated point of the packing instrument touched upon or placed (not pressed) against the gold, in a manner similar to that of making dots on paper with a pencil. Light, medium, or hard blows can be made without changing the adjustment of the instrument, as full or heavy lines are made on paper with a pen. When the electro-magnetic mallet is brought into operation and guided as indicated above, gold can be carried against and over the margins (even frail edges) of enamel without fracturing them, and without the packing instrument passing off and puncturing the rubber dam and wounding tissue. Almost the same blow is required throughout each and every operation, because the gold should be solid and uniform in density, hence the action of

the battery must always be about the same in intensity and constancy, and the pieces of gold for a given operation ought to be nearly the same size ; all foil should be rendered cohesive, by passing through the flame.


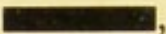
“The successive and rapid recurrence of the blows enables an operator, with careful and intelligent guidance of the instrument, to go over the whole surface of the foil much better, and make the gold more solid and uniform in density with greater ease and rapidity than by any other known method.”

Having considered briefly the various instruments used, we will pass to the consideration of the actual filling of the cavity. In this country two forms of gold are generally employed, viz., Tape and Pellets. The tape is usually obtained by folding up sheet gold to the required thickness, though some firms now sell the gold ready folded up, when it only requires cutting to be ready for use.

Gold foils are generally numbered according to the weight of the sheet ; thus a sheet of gold measures 4 ins. square, and if it weighs 4 gr. it is termed No. 4 thickness, if 8 gr. No. 8 thickness etc. ; so that when we speak of 48 tape, we simply mean tape of such thickness, that if we had a sheet of gold of the same dimensions it would weigh 48 grains. Now the tape usually employed is from 32 onwards, and this may be obtained by folding a much thinner foil to that thickness. Thus, supposing you wish to use No. 32, you would take a sheet of No. 4 foil and fold it once so as to make it No. 8 thickness, then again to make it No. 16, and again to take it to No. 32. When using it thicker, three sheets can be folded at once. Instead of thin foils thus folded, some use heavy or rolled gold of thickness averaging from 20 to 60 ; this form is extremely cohesive, and useful for contouring, but it is not so easily worked, and does not adapt itself to the cavity so well as tape prepared by folding.

For folding gold a pad and foil knife will be required ; these can be obtained at any of the depôts, care being taken that the edge of the foil knife is perfectly straight.

Having folded the gold, the next step is to cut it into strips, and an easy method of cutting it quickly and regularly is as follows:—Take the folded gold in a pair of tweezers, held between the thumb, first and second fingers of the left hand, then take the foil scissors in the right hand, resting the lower blade on the third and fourth fingers of the left hand; by this means the scissors are steadied and the gold may be cut to any width desired.

The thickness of gold used varies; for retaining-pits and difficult cavities No. 32, for more accessible places Nos. 48, 64, 96, but in using the heavier foils considerable practice is required. The width of strips also varies, for retaining-points one practically as fine as can be cut ; for difficult cavities, , and for more accessible places according to the breadth of the cavity.

The other form of cohesive gold, viz., pellets, requires but short notice. There are numerous makes in various shapes and sizes; the cylinders are the most useful form, and of these Wolrab's are as good as any. They are semi-cohesive, and work softly and easily.

As to choice between the use of foil and pellets, considerable difference of opinion prevails. Foil is, without doubt, the better, especially for building over edges and contouring. Those, however, who use pellets, claim that they are more easily and more quickly worked. In some cases they may be more facile in working at first, but as to rapidity in working there is a doubt, for when able to manipulate foil of 64 thickness onwards with the electric mallet the advantage of tape over cylinders in saving time is considerable.

In using cohesive gold, care should be taken to avoid touching it with the hands, since moisture, grease, and exposure to air, destroy its cohesiveness. Though foils are sold as cohesive, it is always best to pass them through the flame before working, and for this purpose a spirit lamp should be used. A Bunsen burner leads sooner or later to failure, owing to the impurities contained in the gas. In annealing, care should be taken not to

overheat the gold, since many kinds become harsh when exposed to a high temperature. Good cohesive gold can be annealed to a dull red heat without becoming harsh.

For *starting cohesive cavities*, two principal methods are in vogue, the one by the use of starting-points, and the other by wedging a large cohesive cylinder into the base of the cavity. The former method is generally employed for starting fillings in front teeth and approximal cavities in bicuspid, etc., when filled with cohesive gold throughout; the latter method principally in crown cavities, where in drilling starting-points a risk is run of injuring the pulp.

For facility of description, we will consider the filling of cavities under three main heads, viz., (1) filling crown cavities; (2) filling approximal cavities in molars and bicuspid; (3) filling approximal contour cavities in front teeth.

Crown cavities.—These cavities, occurring typically in molars, are best started with cylinders, the method being this:—Take two or three large cylinders, according to the size of the cavity, and place them with their ends upward in the cavity, then, with a suitable *plugger*, *tuck* the cylinders round the margins of the cavity, leaving the centre. By this proceeding the cylinders are only slightly condensed, but the gold is placed in a suitable position. Now, with a plugger in the left hand (the pattern is of no importance) steady the cylinders, whilst with the use of firm pressure, first round the edges towards the walls, then in the centre, the gold is closely condensed.

It is extremely useful to condense with these cylinders a strip of cohesive tape, the latter enabling the operator to start his cohesive foil more easily.

The cylinders being steady, anneal a piece of tape by gently passing it through the spirit flame (keeping the part between the tweezers in the flame a little longer than the rest); place it in the cavity and condense with suitable pluggers, using either hand pressure or mallet force. In condensing, fold the gold over so that each fold lies parallel with the floor, and exert the force in a direction as far as possible towards the walls of the cavity. The

piece being in position, fresh portions are added, and thoroughly condensed until the cavity is full.

In malleting, the force of the blow should be directed towards the walls of the cavity, the most inaccessible parts being filled first, and the filling kept, if anything, a little higher towards the walls than the centre. Now, it is impossible to build the gold so accurately as to bring it exactly flush with the edges of the cavity, hence it becomes necessary in filling to mallet the gold over the edge, and when the plug is completed, to cut down the surplus by means of burs and corundum points.

The most important, and at the same time the most difficult, part of a filling to execute with accuracy and nicety is the operation of building over the edges. It can be accomplished as follows:—Tuck down a strip of gold near the margin of the filling, and having carried the tape over the edge, refix it again over the same spot (fig. 218). A loop of gold is thus left simply hanging over the edge; first tap this loop down gently, and then mallet, taking care not to use too much force (fig. 219). Having built

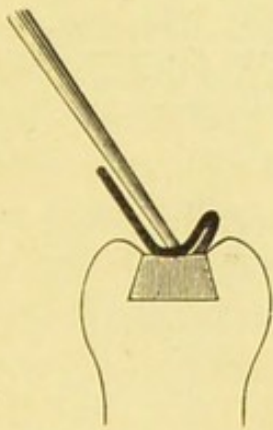


FIG. 218. Showing loop hanging down.

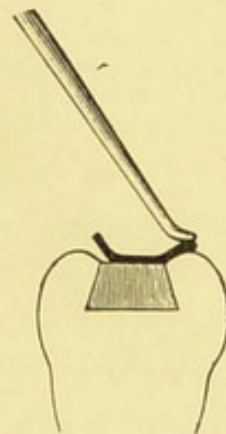


FIG. 219. Showing loop malletted down.

over all the edges, and filled up the centre of the cavity to the right level, the next step will be to trim the filling by cutting down the surplus over the edges, smoothing the surface and polishing. For this purpose, finishing burs and corundum points are used, the former for cutting away the surplus over the edges, the latter for smoothing the surface.

In using these, care should be taken to cut in a direction from the filling to the tooth, rather than from the tooth to the filling, because in the former position one is likely to burnish the gold over the edges, in the latter to tear the gold away from the edge. When the edges have been trimmed, the attention should be turned to the bite, care being taken that the filling is not high (a most important point). Having ascertained that the bite is not obstructed, the surface should be smoothed first with a corundum, and then with an Arkansas or Hindostan stone, the object of the latter being to remove scratches and so produce a higher finish; finally com-

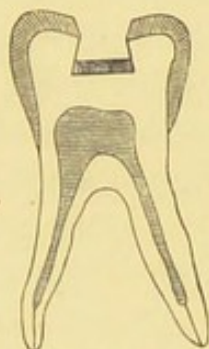


FIG. 220. Showing the filling started by wedging cylinders into the base of the cavity.

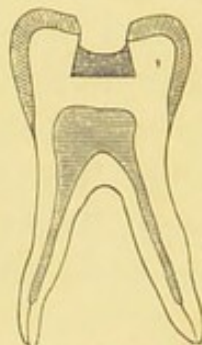


FIG. 221. Showing how to fill the cavity, keeping the gold a little higher against the walls than in the centre.

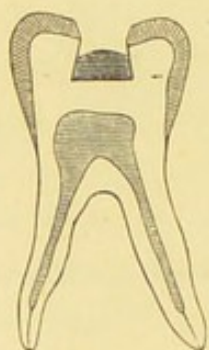


FIG. 222. Showing how not to fill the cavity, "not to keep the gold higher in centre than at sides."

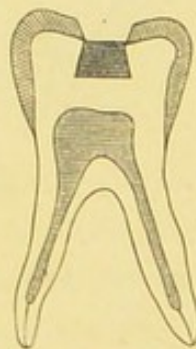


FIG. 223. Showing the time to build over edges.

plete the operation with some pumice on either a wooden or rubber point. The various steps in filling a molar are diagrammatically illustrated in figs. 220 to 225.

In trimming the edges, endeavour should be made to get a joint between the enamel and gold so perfect that the finest probe passed from the filling to the tooth, or *vice versâ*, does not

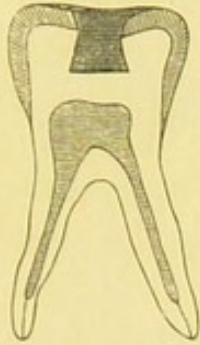


FIG. 224. Showing the cavity filled ready for trimming.

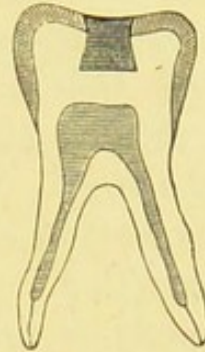


FIG. 225. Showing the filling completed.

catch, the edges being considered trimmed when the probe passes over all the parts without catching.

Approximal cavities in bicuspid and molars.—These cavities are best started by retaining-pits, one at either angle of the cervical edge. For filling these pits, tape will be required of about No. 32 thickness, the breadth being the same as that of the pit to be filled. The best shaped instruments for filling are those illustrated in fig. No. 1 of Webb's set, and Rogers' retaining point plugger, the point of importance being that the plugger should be a little smaller than the diameter of the pit, so as to overcome the tendency of the former to cut the gold when filling. In annealing this piece of gold, the end contained in the tweezers sometimes does not get thoroughly annealed. This may be avoided by first annealing the strip of gold, holding it by one end, and then having taken it up by the opposite end, again passing it through the flame. Having annealed the strip, gently lay it over the orifice of the pit by means of the tweezers, then with the retaining point plugger invaginate the gold into the pit, and in removing the instrument, give it the slightest amount of rotation (this will avoid its bringing out the gold). The gold is now tucked in, in successive folds, until the cavity is full, firm pressure being used, as this point is necessarily one of the most vital in the filling. Having filled the retaining pits,

bridge the gold across from one to the other, condensing the foil in layers parallel to the floor. The next step is to build from this bridge of gold in a direction towards the cervical edge, using exactly the same methods as described under crown cavities; and having looped the foil over the edge, it is an excellent plan to chop off with the mallet (electric or hand) any superfluous material, thus, to all intents and purposes, burnishing the gold against the edge. Too much care cannot be bestowed on this part of the cervical edge, as it is far and away the most important part of the filling.

This operation being satisfactorily completed, fresh pieces of foil should be added until the cavity is full, care being taken to keep the gold flat, and, if anything, a little higher against the walls than in the centre, and a little higher on the contour surface than towards the medium line of tooth. The edges are built over as the cavity fills, the crown surface and edges being completed last. In filling these cavities, build out contour, restoring as far as possible the original shape of the tooth. The finishing of these fillings is accomplished as follows:—The cervical edge and upper part of the plug are first roughly trimmed down with plug trimmers, care being taken to use these instruments so as to cut in a direction from the gold to the tooth substance for reasons previously stated. Strips of emery tape should now be used in a lateral direction on the approximal and cervical portions of the filling.

To make sure that the cervical edge is thoroughly finished it will be necessary, as in the case of crown cavities, to test with probes, and wherever a catch is discovered the tape or plug trimmers must be again brought into use. The lower part of the approximal surface may be trimmed down with a disc of emery, and this part of the filling is also best finished with emery tape, as one can more easily get a nice contour with this than discs. If discs are used to finish the cervical margin it will be found extremely difficult to prevent destruction of the contour of the filling. The crown surface is trimmed in exactly the same way as described when treating of crown cavities. The contour

surface is polished with either a little pumice on ordinary sewing tape, or with rubber caps or discs on the engine. Figs. 226-230 represent the various stages and steps above described.

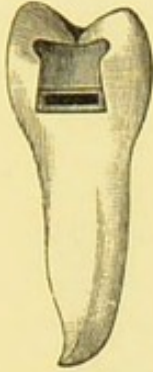


FIG. 226. Showing gold bridged between retaining points.



FIG. 227. Showing gold built over cervical edge.



FIG. 228. Showing how to build, keeping the gold a little higher against the sides than in the centre.



FIG. 229. Showing cavity full.



FIG. 230. Showing the filling trimmed and completed.

Approximal contours in front teeth.—In these cavities great care must be taken to get the gold in absolute contact with the front wall of enamel in order to avoid that bluish appearance sometimes seen in front teeth filled with gold. In filling, the method of procedure should be as follows:—First fill the retaining points at the cervical margin, bridge between them and build

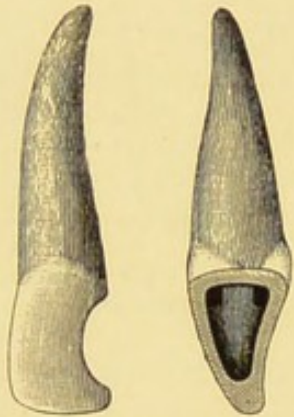


FIG. 231. Showing side and front view of cavity.



FIG. 232. Showing retaining points filled and bridged between.

over the cervical edge as recommended above. Next build the filling down a little way, contouring to the required shape, and taking especial care to well fill the posterior wall (fig. 233). Now



FIG. 233. Showing filling built down slightly and contoured.



FIG. 234. Showing actual cavity filled in.

finish filling in the actual cavity (or hold for the filling), paying especial attention to filling in any grooves if they exist, and also the opposing point. (This stage is represented in fig. 234.)

Next build over the posterior wall and edge, taking the filling out to the required contour (fig. 235), and this accomplished, fill



FIG. 235. Showing posterior wall built over.

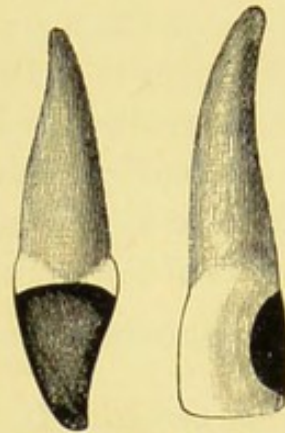


FIG. 236. Showing filling completed.

the tooth in, first building over the anterior edge, and out to the required shape. One recommends building over the posterior edge principally because the tendency is, if very careful attention be not bestowed, for the operator to build the filling out to the contour of the tooth in front, leaving the posterior wall, which is excessively difficult to get at when the filling is completed in front. These fillings are best finished with plug trimmers and tape at the cervical edge, discs and tape for the approximal surface, small corundum wheels for trimming the anterior surface, oval finishing burs, and small corundum wheels for the posterior surface. For polishing, pumice on rubber points, or ordinary sewing tape, should be used.

In the foregoing description no attempt has been made to explain in accurate detail the filling of cavities, but rather to glance over the order of proceeding. There are, of course, many other shapes of cavities requiring filling beside those described, but the method is practically the same, viz. :—(1) To fill retaining points when present ; (2) to bridge across between them, and then build over the cervical edge ; (3) to build the filling up as level as possible, keeping it, if anything, a little higher against the walls of the cavity than in the centre ; (4) to build over the edges as the filling advances.

(ii.) *Non-cohesive method.*—For this method, as with cohesive, the gold is prepared either in sheets or as cylinders. The sheet is usually introduced in one of three forms, *i.e.*—

- (1) Tape or Ribbon ;
- (2) Rope ; or
- (3) Stars or Strips.

Whichever method, however, is selected, one golden rule holds good, that the folds of sheets or cylinders must be placed parallel to the walls of the cavity.

(a) SHEET.

(1) *Tape method.*—In using the tape method, a sheet of No. 4 foil is cut into three pieces, and each folded with the foil knife until their breadth is about equal to that of the cavity. The strip is then taken up by the conveying forceps in the left hand and conveyed to the cavity, and with a suitable instrument in the right hand pressed down into folds parallel with the walls, each fold being left projecting slightly above the orifice of the cavity. When a few folds are arranged, they should be firmly compressed against the side of the cavity with suitable instruments.

When one length of tape is exhausted, another is introduced ; and so on, until the cavity is as full as possible. The filling is then thoroughly condensed. This step completed, the surface should be tested by endeavouring to force into the gold an instrument of wedge shape. This is practically “riggled in” by moving it in a lateral direction ; the hole made is then filled up with tape or very small cylinders. This process (*viz.*, forcing in the wedge-shaped instrument) is continued until it requires some considerable force to introduce the plugger into any part of the filling. The surface of the plug is now thoroughly burnished with either a hand or engine burnisher. This latter instrument is useful, and the filling is then trimmed down in exactly the same manner as recommended above, with the exception that after the use of the pumice the burnisher is applied to the surface, and especially the edges.

(2) *Rope method*.—In this method the sheet, instead of being folded in strips, is rolled into a form resembling rope. There is practically no difference in the way of introducing it to that just described.

(3) *Stars or strips*.—In this variety the sheet is folded into broad strips of about a half to three-quarters of an inch in breadth, and then cut at right angles into narrow strips. These are then arranged as shown in fig. 237, and inserted, with the

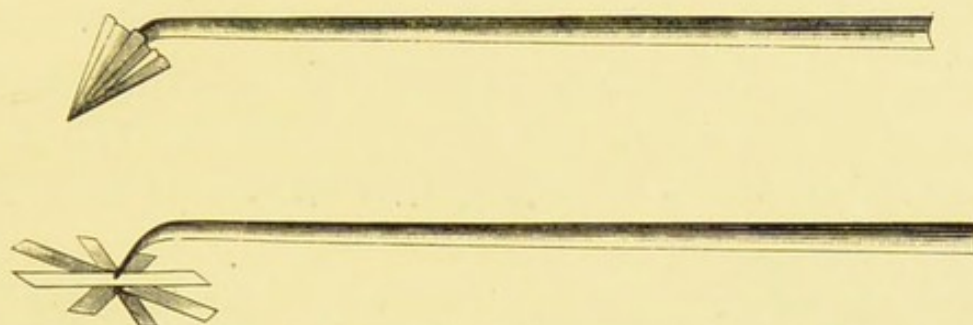


FIG. 237.

central portion downwards, into the cavity, the projecting ends being folded downwards and inwards, and compressed. Fresh portions are added in like manner until the cavity is full, the plug being finished in the usual way. This process is useful for small deep cavities, and also for introducing the finishing portions into larger fillings.

(b) CYLINDERS.

Cylinders are the most convenient form in use for introducing non-cohesive gold, and one of the most serviceable is that known as Ash's Non-cohesive, Style C. This form of non-cohesive gold is introduced as follows:—

Take three, four, or more (the number depending upon the breadth of the cavity) between the blades of the conveying forceps, and, compressing them laterally, place them in position towards the posterior part of the cavity (fig. 238), holding them in place with an instrument in the left hand; condense them first on one side, then on the other, and finally in the centre. In this

way continue to introduce and condense fresh rows of cylinders until the cavity is a little over two-thirds full (fig. 239). A



FIG. 238.



FIG. 239.

different mode must now be adopted: the cylinders should be placed round the side of that part of the cavity which is still unfilled and condensed by wedging from the centre (fig. 240), the

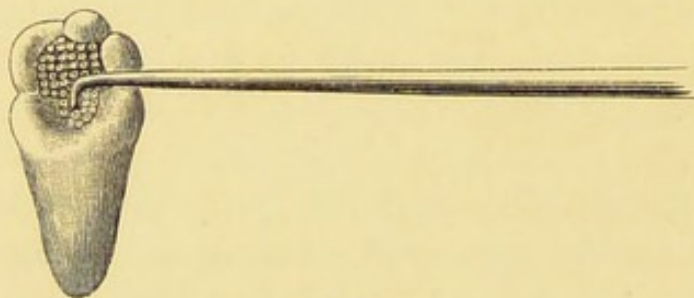


FIG. 240.



FIG. 241. Filling trimmed and completed.

last portion of the filling being introduced in the form of tape. The surface is now condensed, and the plug treated in exactly the same way as described under the tape method. Very often it will be found difficult to get the row of cylinders first introduced steady when condensing; if, however, they are simply placed in position and a second or even third row added before commencing condensing, the difficulty will be overcome.

Non-cohesive gold can be most advantageously employed in crown cavities, and on the cervical edge of interstitial ones, in combination with cohesive. The advantages claimed for non-cohesive gold are that it adapts itself better to the walls of the cavity than cohesive, and also that it is quicker to work, a point of great importance in practice.

(iii.) *Combination of cohesive and non-cohesive methods.*—The combination of cohesive and non-cohesive is a very favourite plan with many operators. Cavities in approximal surfaces of bicuspids and molars are those usually filled by this method, the mode of procedure being as follows :—

Take two or three non-cohesive cylinders according to the breadth of the cavity, and place them along the cervical floor, so that the ends project outwards, not downwards. Gently condense these with the idea of getting them steady, and add another row, condensing again, first on one side, then on the other, and finally in the middle, since by these means you are not so liable to make the gold tilt. This proceeding is continued until the cavity is about one-third full (fig. 242), when the

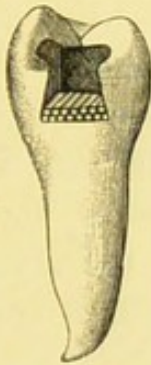


FIG. 242. Showing non-cohesive cylinders in position.



FIG. 243. Showing the cavity completed, the light part being the non-cohesive, the dark part the cohesive portions.

cohesive gold is started by wedging up a large uncondensed cohesive cylinder; and to this latter tape is attached and the filling completed as described under the cohesive method, the plug being finished in the usual way.

The advantage claimed by advocates of this method is that a better joint at the cervical edge is obtained than with cohesive, whilst those who oppose this method maintain that the non-cohesive gold is forced out by the power of mastication and forms a ledge for the lodgment of food, etc., at the cervical edge.

When the combination method is used for filling molars the

floor, walls of the cavity, and edges, are filled with non-cohesive gold, the centre of the plug being completed with cohesive (fig. 244), the idea being that the non-cohesive adapts itself better to

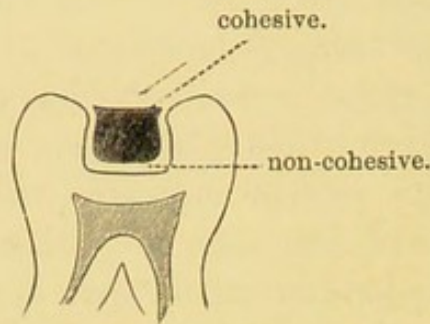


FIG. 244.

the walls of the cavity than the cohesive, while, on the other hand, the latter allows the filling to withstand mastication better than the former.

In approximal cavities in front teeth a combination of cohesive and non-cohesive gold will be found useful, especially in those cases not involving much of the labial and lingual walls. In such cavities the cervical margin, lingual wall, and portion towards the cutting margin, can be filled with the non-cohesive, leaving only the portion towards the labial wall to be fitted with cohesive (fig. 245).

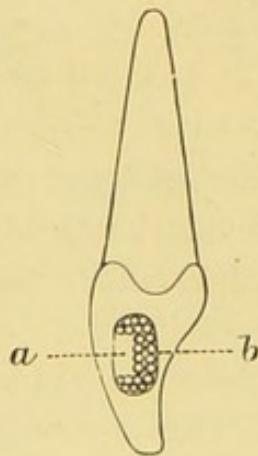


FIG. 245. (a) Cohesive; (b) non-cohesive.

(iv.) *Gold in combination with other metals—Gold and tin.*—This method has many advocates, who claim that it is comparatively

easy to make water-tight fillings with this combination, and still more that it has a preservative action on the tooth substance. The great disadvantage is that it turns black, and so in front teeth is unsightly.

There are two principal ways in which it can be used, viz., (1) exactly the same method can be pursued as when using a combination of cohesive and non-cohesive (the tin taking the place of the latter); (2) by intermixing it with the gold as follows:—One sheet of tin being placed between two of non-cohesive gold, and the whole folded up into either tape or rope, the material is introduced into the cavity as recommended above for the non-cohesive gold. This works extremely softly, but subsequently some chemical action takes place, the surface becoming quite hard and gritty. The filling is not of a good colour.

Gold and amalgam.—This combination is extremely useful in cases where the cervical edge is below the gum, as, for instance, in the buccal cavities of molars and interstitials, where the cervical edge of the cavity is high up and inaccessible.

The combination is used in two ways:—(1) By filling at the first visit the part of the cavity where the amalgam is to be used in the ordinary way, putting some soft gutta percha or cotton-wool and mastic into the remaining part, and at the second visit trimming the amalgam, and filling the remaining portion of the cavity with gold. (2) By filling at one visit with amalgam, removing all excess of mercury, and then starting the gold on the top of the soft amalgam; the first two or three pieces of gold apparently disappear, but the gold soon takes up the residual mercury and the rest of the filling retains its ordinary colour. When this is the case the filling is completed exactly like a simple cohesive gold filling. Some argue that electric action is set up by the combination of gold and amalgam.

Gold and platinum.—With this combination the leaves of platinum are gilded and made adhesive, and then worked in in parallel layers. Great care is required to thoroughly anneal the strips and also preserve the parallelism, since if this last is

not done when the filling is completed patches of gold will show on the surface. This combination is said to be valuable for cavities on the labial surfaces of front teeth, the tint approaching the colour of the normal tooth.

Gold and osteoplastics.—This combination is used principally as a means of starting cavities. In deep cavities, when it is found needful to put in a covering of osteoplastic, it is useful before the filling has hardened to knead into it one or two strips of cohesive gold; by this means an excellent holdfast is obtained.

(2) *Tin.*—Tin, when used alone, is inserted on the same principles as non-cohesive gold, but in working it will be found more plastic.

(3) *Plastics—Amalgam.*—There are many ways of inserting amalgam fillings, and of these, three call for special mention. Dr. Flagg, who is a great authority upon plastic fillings, objects to the method of burnishing in the separate portions, maintaining that it is impossible to get union between successive pieces. He recommends that each piece should be worked into place by serrated pluggers, the force used being a succession of light blows. Dr. Bonwill's method has many advocates, and certainly leads to good results. He uses amalgam fairly plastic, and proceeds as follows:—A small quantity is introduced into the cavity, and over this a pad of bibulous paper is placed and firmly pressed against the amalgam with suitable instruments, burnishers, tweezers, etc.; the pad is then removed and is seen to contain a certain amount of mercury, while, at the same time, a large amount is also seen upon the surface of the filling; this is removed and another portion of amalgam inserted and treated in the same way, much pressure being used in its insertion; by these means the cavity is filled, great care being taken to remove the surplus mercury from the surface.

Mr. Kirby, to whose experiments we have already referred, adopts the following plan which also yields excellent results:—Two portions of amalgam are mixed, the first by taking equal parts by weight of mercury and filings, varying the latter a little according to its quality: this is the soft amalgam; the second

or dry one is made by taking twice as much filings by weight as mercury. The first half or two-thirds of the cavity is filled with the soft amalgam, and is worked into position with a burnisher, without any undue pressure; the upper half or third of the

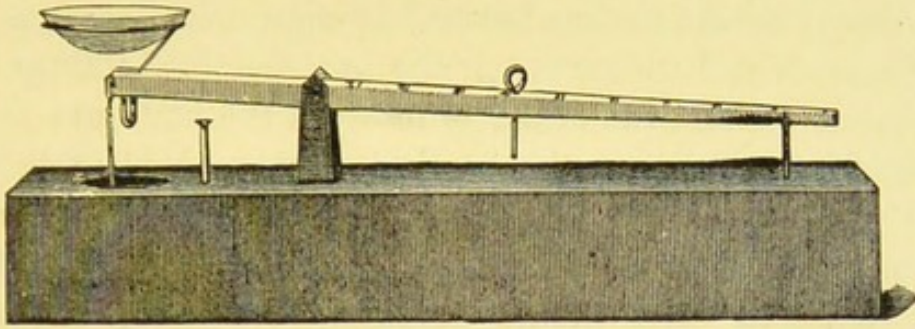


FIG. 246.

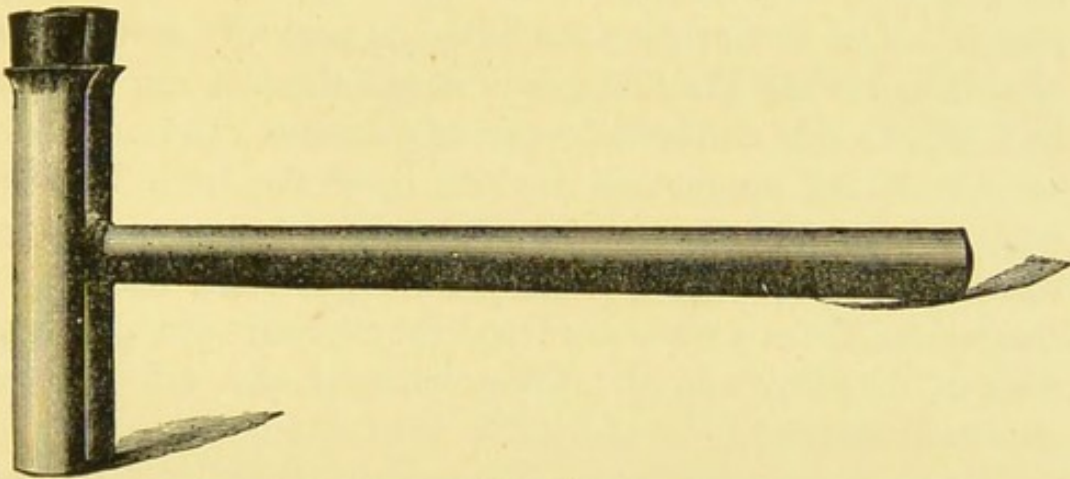


FIG. 247.

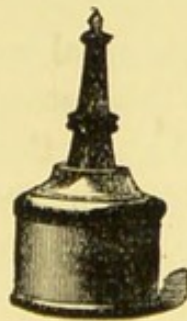


FIG. 248.

cavity is then filled with the dry amalgam in much the same manner; the filling is then trimmed into shape. Mr. Kirby lays

great stress upon the accuracy of the proportions in preparing the amalgams, and, to ensure this accuracy, has designed a balance which turns to the fraction of a grain (fig. 246). He has also introduced a mercury holder and mixing tubes, illustrations of which are shown in figs. 247 and 248.

Matrices should always be used in approximal cavities, as it is nearly impossible without their use to insert good fillings in these situations. When the filling is inserted the amalgam should be trimmed, especially at the cervical edge, and when thoroughly hard polished in the same way as an ordinary gold filling. For trimming the approximal surface of the filling, a strip of rubber dam dipped in water should be passed between the teeth to the cervical edge, and gradually withdrawn with a side-to-side motion; by this means the surface is left quite smooth. Another good plan is, before commencing the filling, to pass up a double strand of silk, and when the filling is inserted, the silk can be moved from side to side and withdrawn. Another method adopted by some in filling approximal cavities is, if the teeth have been separated, to fill between the two with one mass of amalgam, then trim the fillings towards the cervical edge, leaving them continuous above; when hardened they are divided at this part with a fine disc, and the filling trimmed and polished to the required contour.

Osteoplastics and amalgam.—This combination is found to possess nearly all the adhesive properties of oxy-phosphate, with the advantage of being better able to resist mastication. For use, the amalgam is mixed in the usual way, care being taken to avoid an excess of mercury; the osteoplastic is then mixed a little thinner than usual and the two thoroughly blended together, the filling being inserted like an ordinary osteoplastic one. The amalgam in the mixture should vary between one-third to one-half of the whole bulk.

A filling composed of the fluid of the oxy-phosphate, combined with the powder mixed with amalgam filings, makes a serviceable filling in the mouths of children. Osteoplastics and amalgams are also combined as follows:—A mixture of osteoplastic is

smear round the cavity, and the amalgam inserted before the osteoplastic has set. It is claimed by advocates of this method that the amalgam so inserted does not shrink, and that an actual adhesion of the material to the walls of the cavity takes place.

Osteoplastics.—No very definite directions can be given for the insertion of these fillings, but great care should be taken with them, if they are to be permanent. It is important to exclude the saliva, and the rubber dam should therefore be applied whenever practicable. For mixing, a glass slab should be used, the edges of which are quite square; the spatula used should be stout, quite flat, and have square edges. The consistency of osteoplastic used will to a great extent depend upon experience; it should not be inserted too dry, a fairly plastic condition being the best. The filling should be worked into place, and with suitable instruments, and if the osteoplastic sticks to these, the lubricating of the instruments will prevent it; the setting can be accelerated by the use of the hot air syringe, and the filling completed by trimming with cuttlefish discs, etc.

Mr. Humby has lately shown that it is possible to retard the setting of these cements by mixing them on a slab of metal with a metal spatula, the slab being made of pure copper, covered with thin layers of pure nickel. The delay in setting is supposed to be caused by the absorption of the heat generated by the combination of the liquid with the powder.

Gutta percha.—To insert this material, the following plan should be adopted:—The variety to be employed must be cut into small pieces, and heated on a hot-water tray or dish; if softened by passing through the flame, the gutta percha is not evenly heated, and is liable to be scorched. The cavity should be thoroughly dried, and some operators wipe it round with a solution of gutta percha or shellac in chloroform, evaporating the chloroform with hot air from a syringe before inserting the gutta percha, the use of these making the filling adhere to the walls of the cavity. The heated gutta percha is then conveyed and is packed into the cavity with suitable instru-

ments, this proceeding being continued until the cavity is somewhat over full; the surplus is removed with thin spatulæ heated nearly to redness, and the surface smoothed with a polished burnisher, or by employing a pledget of cotton-wool dipped in chloroform, rubbed over the surface; the disadvantage of this latter method is that the surface is rendered more porous than is the case when the fitting is finished with a burnisher.

Porcelain inlays.—Porcelain inlaying is the process by which a piece of porcelain is inserted into the duly prepared cavity of a carious tooth. The advantage of this method is that the unsightliness of large fillings in exposed surfaces is obviated, the inlay used being the same colour as the tooth. The disadvantage of the method is that the inlay is inserted with some variety of osteo filling, which has a tendency to wash out. The most suitable cavities for porcelain inlays are those occurring upon the labial aspect of the upper front teeth, but their use is by no means limited to such cavities.

The mode of proceeding in simple cavities, namely, where all four walls are standing, is as follows:—The cavity is shaped with fine cut burs and made circular at its orifice, the sides are made to diverge very slightly, the base being left flat. For performing this portion of the operation, special burs are made. A rod of porcelain of the right colour and approximate size is selected, and from this a disc is cut off and fastened by means of shellac to a mandril rotated by the engine. With corundum wheels, this is accurately fitted to the cavity, the disc, when lying in the cavity, should project slightly beyond the surface of the tooth. The inlay is fixed with some form of osteo mixed thin. This is allowed to harden, and then with a corundum wheel the inlay is ground flush with the surface of the tooth, and with an Arkansas stone and a little putty powder the inlay is finally polished.

The cavity may however be of such a shape that the process of making it circular will involve the cutting away of much sound tissue. Such cavities should be cut oval. The inlay is then

prepared ; but during this process, it will be necessary to hold the inlay between the fingers.

In addition to the rods of porcelain kept by the depôts, Messrs. Ash & Sons also keep a stock of porcelain of various shapes, sizes, and colours, so that by a careful selection but little fitting is necessary. Mr. Dall, who is a great advocate of porcelain inlays, makes his own "stoppers," the plan he recommends being as follows¹ :—"For compound cavities take a diatoric lower or upper front tooth, and, after cutting off the back with a diamond disc, grind to a shape nearly resembling the section of a half round file. Hold this piece of porcelain in the left hand between the finger and thumb, and, with a rapidly-revolving disc in the handpiece, cut off the stoppers, each of which must be grooved before separating. Round stoppers may be made by cutting a tooth in sections lengthwise, and then fastening one of these into a trephine or port-polisher with a piece of shellac. It is now rapidly revolved by the dental engine, resting it lightly on a large mounted diamond disc. By this method you can make them perfectly true, and of any size. The smallest which I make and use for pitted teeth is less than one-sixteenth of an inch in diameter. Stoppers required for compound cavities with cutting edge are made from flat teeth with pins, the pin or pins being retained in the stopper." For making the "stoppers" diamond discs and points will be found invaluable.

In compound cavities, namely, those involving two or more surfaces of a tooth, the whole cavity may be fitted with porcelain, or the plan adopted by Mr. Dall may be used, viz., the cavity partly filled with either gold or amalgam, the labial portion being completed with porcelain. In carrying out this proceeding the inlay is roughly fitted, the amalgam or gold is next filled into the cavity and trimmed, and the inlay is then accurately fitted and fixed. Very much time and trouble may be saved the operator by taking an impression of the cavity and the neighbouring tooth, and having the inlay roughly prepared in the

¹ *Journal of British Dental Association*, 1890, p. 722.

workroom. Inlays may be used for molars and bicuspid, but their use in such cavities is of little value.

Glass inlays.—Inlaying with glass was first suggested by Dr. Herbst, but did not come much under the notice of the profession until Dr. Richter introduced his improved materials. These can now be obtained at any of the depôts, the box containing all the requisites needful for carrying out the operation. The preparation of the cavity for a glass inlay is similar to that for porcelain. The inlay is made as follows:—Take a piece of platinized gold foil, No. 60 (Williams), about three times as large as the opening of the cavity, place this over the orifice, and gently press it inside by means of a small ball of cotton-wool twisted round the points of a pair of pincers, until it is closely adapted to the sides, and forced into all the crevices of the cavity. (It is needless to say that all undercuts must be temporarily filled.) When the cavity is large, it will be necessary to use two or more balls of cotton-wool in order to get the foil thoroughly against the sides of the cavity. Care must be taken in forming the impression of the cavity to see that the margins are sharp; this is most important. The matrix or impression is now withdrawn from the cavity with a pair of pincers. The inlay material of the required colour is now mixed to the consistency of cream, and a small portion placed in the matrix, any surplus moisture being removed with blotting paper. The inlay is now fired by holding the matrix over a flame of an alcohol lamp. Dr. Richter lays great stress upon the use of an alcohol flame. When the inlay is cool, a little more material is added, and the whole fired again, this proceeding being continued until the matrix is full. By making the inlays in stages as recommended shrinkage will be quite overcome, and the inlay will be more perfectly formed. Great care must be taken to make the inlay the exact size of the cavity, as the glass will not bear grinding down as can be done with porcelain. The inlay when cool will easily shell out of the foil matrix, and can be then cemented in position with some form of oxy-phosphate.

CHAPTER VIII.

THE DENTAL PULP AND ITS TREATMENT IN HEALTH AND DISEASE.

Treatment of the Normal Dental Pulp.

WE propose to deal with this subject under the two headings:—

- (a) When the pulp is not exposed ;
- (b) When the pulp is exposed by traumatism.

(a) **When the pulp is not exposed.**—In the insertion of fillings care must be taken to avoid anything which is liable to lead to irritation of the pulp. If during the progress of the caries the pulp has shown evidence of irritation, it must be covered with a layer of some non-conducting material before a metal filling is inserted. For this purpose a layer of oxy-sulphate of zinc will be found very serviceable, and it is well to incorporate with it some oil of cloves. If the layer of tissue between the cavity and the pulp is very thin, it will be better to use a cap, so as to avoid any pressure.

(b) **When the pulp is exposed by traumatism.**—This may arise during the process of excavation of a cavity, through a fracture, or from attrition. The first cause is at times quite unavoidable: opinions differ as to its treatment. Some endeavour to save the pulp by capping; others devitalise the pulp. If the exposure is small and the dentine surrounding it healthy, and the patient fairly robust, we may endeavour to save the pulp; if, on the other hand, the exposure is extensive (e.g., caused by

an instrument slipping into the pulp), or the patient is of weak constitution, it is better to devitalise, as this gives the best results. If it is decided to adopt conservative treatment, the procedure will consist in capping the pulp, but the success of this operation will depend upon the care taken in its execution.

In fixing the cap the following points are of importance:—
(1) To render the parts thoroughly aseptic; (2) to use a cap of non-irritant material; (3) to insure juxtaposition between the cap and its contents and the pulp; (4) to avoid pressure upon the pulp; (5) to prevent the conduction of thermal changes to the pulp.

The best mode of procedure in capping is as follows:—Stop all bleeding from the pulp by syringing with hot water, swab out the cavity with a solution of corrosive sublimate 1-1000; carefully dry the cavity. Mix a thin paste of the powder of the oxy-sulphate of zinc and oil of cloves, introduce this into the concave side of the cap, and place it in position over the exposed pulp, taking care that the margin of the cap rests upon the dentine and not on any part of the exposed pulp. Hold the cap in position with an instrument until it is fixed, then fill the cavity with gutta percha or some osteoplastic filling. The cap employed may be made of any of the following materials, tin, platinum, lead, ivory, vulcanite. These caps are sold ready made by the depôts, but they are easily constructed by cutting a circular piece out of the material used with scissors, and giving it a "cup shape" by pressing upon it with the butt end of an excavator. At times it is very difficult to get the cap into position, especially when endeavouring to do so with the conveying forceps. To overcome this a small hole should be punched in the cap, so that the little flap formed by punching will be on the convex side of the cap. By holding this flap with the conveying forceps the cap may be easily conveyed to the cavity and kept in position. The flap will resume its place with the slight pressure used in filling the remainder of the cavity.

Exposures treated in this way answer very well, but there is always the risk of the pulp eventually dying. If the exposure

is very minute, a piece of ordinary court plaster, dipped in some antiseptic solution to moisten it, is usually sufficient.

Exposure due to fracture of the tooth is more difficult to treat, and in nearly all cases it is advisable to remove the pulp. This should be done by the immediate method, as the fracture is generally such as not to allow a dressing of devitalising material to be applied. In adopting the immediate method nitrous oxide should be administered to the patient, and the nerve removed with suitable instruments, or the root filled at once, or a dressing of some antiseptic material immediately inserted. Exposures due to attrition are rare. In most instances the above treatment will prove best for such cases.

The Diseases of the Dental Pulp and their Treatment.—In considering the pulp in disease it will be convenient to do so under two heads, viz., its pathology and its treatment. Most of the knowledge of the pathology of the dental pulp is due to the researches of Wedl and Black, but much still remains which requires elucidation.

Hyperæmia.—This condition is analogous in all respects to active or arterial hyperæmia occurring in other parts of the body. By active hyperæmia is meant an excess of blood in the arteries of the part, with, in many cases, an acceleration of the flow. The exciting causes leading to this condition are in most cases thermal changes consequent upon taking hot or cold fluids into the mouth. Sweet, acid substances, etc., may also be enumerated as causes. The above produce the hyperæmia probably by partial inhibition of the vaso-motor nerves, causing dilatation of the vessel walls. This susceptibility to thermal and other changes is increased by irritation of the distal end of the dentinal fibrils from their exposure by caries, abrasion, erosion, attrition, etc. Hyperæmia also occurs in teeth filled with materials which are rapid conductors of thermal changes. Occasionally cases are seen in which apparently sound teeth are subject to hyperæmia, but in the majority of such patients the health is much below the normal standard. To obtain sections for microscopical purposes, the tooth, immediately after extraction, must be put into some

hardening fluid, such as Müller's, and allowed to remain in it at least a week before sections are cut. In sections thus prepared and examined, the vessels will be found dilated at certain spots; appearing varicosed, especially if the hyperæmia has been acute. Migration of red blood corpuscles will be seen in the pulp tissue, in the neighbourhood of the vessels which are most distended. This condition may lead to infarction, and diffuse inflammation may follow. Pulp which have been much attacked by chronic hyperæmia generally show a certain amount of degeneration and calcareous deposit; the pulp chamber also will be considerably lessened in size by fresh deposit of dentine (secondary dentine).

The diagnosis of hyperæmia is simple. The patient will complain of lancinating pain when taking anything hot or cold, but in mild cases the patient will only complain of discomfort. In severe cases, the tooth may be so tender upon the slightest touch that mastication becomes unbearable. In such the hyperæmia has extended to the periosteum.

Acute inflammation.—The cause of acute inflammation of the pulp is nearly always exposure of the pulp, resulting from caries; it may, however, be due to violence, the incautious use of arsenious acid for obtunding sensitive dentine, irritation from fillings, or the spread of inflammation from the periosteum, etc. The changes taking place in the pulp during inflammation are the same as those observed in any other tissue: the vessels dilate, exudation of inflammatory products takes place into the surrounding tissue; the ordinary cells of the part becoming destroyed, the inflammatory process terminates in suppuration, and occasionally in resolution or organisation.

The reasons for acute inflammation in the pulp so commonly terminating in suppuration are—that the delicate nature of the tissue of the pulp is unable to withstand an inflammation of any severity; and, secondly, that this tissue being practically in an enclosed bony cavity the pressure from the inflammatory products is far more destructive of its vitality than if it were not thus confined.

The symptoms of acute inflammation are pathognomonic—sharp shooting pain, often of a throbbing character, which is generally more severe at night when the patient assumes the

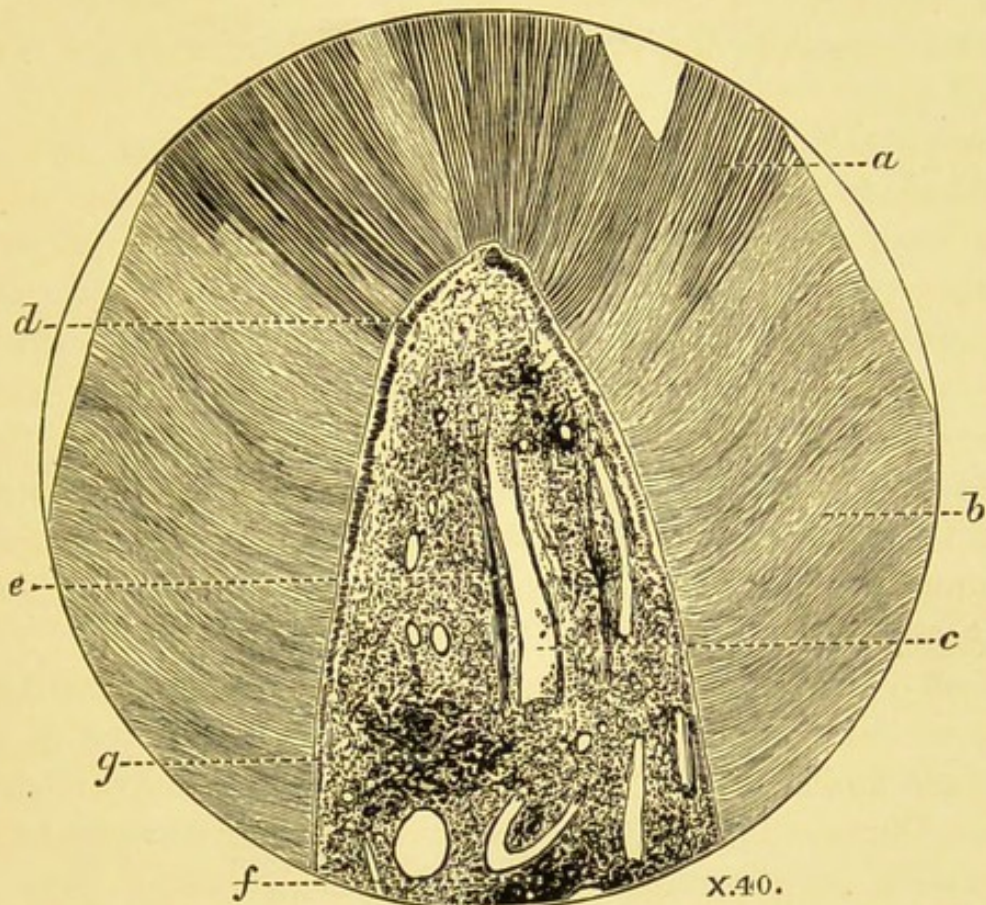


FIG. 249. Acute inflammation of pulp (longitudinal section). (*a*) Carious dentine; (*b*) normal dentine; (*c*) enlarged capillaries; (*d*) degenerate odontoblasts; (*e*) inflamed nerve bundles; (*f*) pulp tissue, filled with leucocytes; (*g*) mass of inflammatory cells breaking down into abscess.

horizontal position. Thermal changes also lead to severe paroxysms of pain, although in the early stages of acute inflammation cold produces relief by constricting the blood-vessels. It is at times difficult to discriminate inflammation from hyperæmia. With the latter, however, the throbbing character of the pain is not so well marked, and the pulp is usually not exposed. Acute inflammation of the pulp must also be distinguished from that of the periosteum, and the main points of difference are briefly as follows:—

IN ACUTE INFLAMMATION OF
THE PULP.

Pain sharp, throbbing, or lancinating — intermittent and reflected.

Thermal changes to the teeth cause pain.

Pressure or tapping on the tooth causes no pain.

Slight pressure on a piece of cotton-wool in the cavity generally causes acute pain.

IN ACUTE INFLAMMATION OF
THE PERIOSTEUM.

Pain dull, heavy, and constant.

Thermal changes do not cause pain.

Pressure or tapping on the tooth causes pain.

Slight pressure on a piece of cotton-wool in cavity does not cause pain, except through pressure transmitted to the periosteum.

Attention to these points will assist in diagnosis, but it must not be forgotten that with acute inflammation of the pulp there is at times a slight inflammation of the periosteum *through* continuity.

Chronic inflammation is caused by the same factors that give rise to acute inflammation; the changes which take place in the tissues are similar to those occurring in other chronically-inflamed parts. Chronic inflammation of the pulp may terminate in suppuration, organisation, or may lead to some form of degeneration. Sections of pulps in which the inflammation is terminating in suppuration show the tissue in the inflamed area packed with leucocytes, which take the place of the normal cells; while in the part nearest to the surface the leucocytes are seen to have undergone degeneration, or, in other words, to have become pus cells—this continuing until the whole of the pulp is destroyed. When the inflammation terminates in organisation the tissue of the pulp will be found to contain a large amount of fibrous tissue, and, in addition, a diminution of its true cellular elements.

Hypertrophy of the pulp also occurs, giving rise to the condition known as “polypus” of the pulp. The cavity will be filled to a greater or less extent with a fleshy-like growth, which

is increased in size by the irritation of the sharp corners of the pulp cavity. The hypertrophy is not confined to the cavity, it also occurs in the pulp chamber, leading to absorption of the hard tissues. Microscopical sections of polypi show them to be composed principally of granulation tissue, with a tendency to develop into fibrous tissue. The surface is often covered with a layer of squamous epithelium (fig. 250), probably due to a kind of

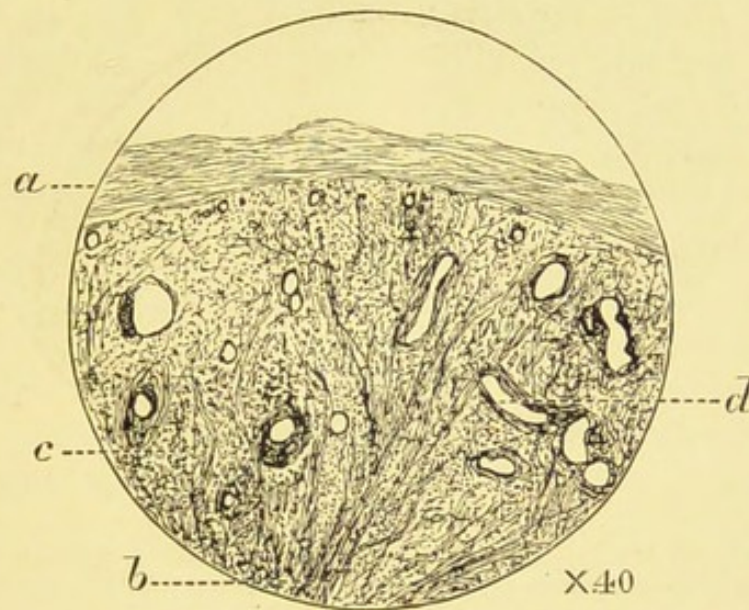


FIG. 250. Polypus of the pulp under a low magnifying power. (a) Stratified epithelium; (b) fibrous stroma; (c) granulation cells; (d) blood vessels.

skin grafting, a small piece of epithelial tissue no doubt having been conveyed to the surface of the polypus during the process of mastication. Under rare conditions the hypertrophied pulp seems to undergo calcification. In one case mentioned by Mr. Tomes a patient had an upper molar fractured through the pulp chamber. Previously to the operation the patient had suffered pain, which disappeared after the attempt at extraction. A few months afterwards the tooth was removed, and it was then seen that a mass of secondary tissue not only projected from the pulp chamber, but also hung over and concealed the margin of the carious cavity.¹ An interesting case of calcification

¹ Tomes' *Dental Surgery*, 3rd edition, p. 431.

following hypertrophy is also narrated by Black.¹ When the inflammation is very chronic degeneration in structure may occur.



FIG. 251. Polypus of pulp (longitudinal section) from near its junction with the tooth. (a) Fibrous stroma; (b) large granular cells (no capillaries visible).

In connection with chronic inflammation deposits of calcoglobulin are seen, always occurring, when present, in the inflamed area in the region of the exposure, the deposits being generally irregular in shape and at times reaching to a considerable size. Dr. Black, who was the first to describe them, states that "when mounted in glycerine without staining these masses are very transparent, and show no colour whatever. They stain an intense red with fuchsin, and are not bleached by immersion in alcohol for five or six hours. With hæmatoxylin they are stained blue or purple." He considers that they are connected with the formation of pulp nodules, and may therefore occur in pulps not attacked by inflammation. This probably is the condition described by Wedl as colloid degeneration.

¹ *American System of Dental Surgery*, vol. i. p. 859.

Fatty degeneration of the dental pulp.—The dental pulp is usually seen in senile teeth, temporary teeth which are undergoing absorption, and in teeth the pulps of which have been capped. To the naked eye it shows itself by diminution in volume, recession, and discoloration of a pale reddish-grey. The surface of the pulp is covered with degenerated odontoblasts which form a cloud-like layer. Microscopically the parenchyma of the pulp will be seen to contain fat globules, and these are also seen forming chains, following the course of the vessels and nerves. The medullary sheath of the nerves and the walls of the vessels also undergo degeneration.

A net-like or reticular atrophy is described and figured by Wedl. To the naked eye the pulp appears stiff, flattened, and shrivelled, is of a grey-yellowish or red-brown colour, produced by the decomposition of the blood. Under low magnifying powers a superficial reticular network is seen, at the edges of which the odontoblasts appear shrunken, while, if the atrophy is far advanced, they will have disappeared. The blood-vessels appear larger than usual and have thin walls, so that it is impossible to distinguish between arteries and veins. The nuclei in the sheath also have disappeared. The course taken by the vessels is irregular, and they are seen to freely intertwine and present also at places marked constrictions due to the contraction of the connective-tissue trabeculæ. Under higher powers (300 diameters) the network is more plainly seen, the bundles of tissue interlacing and forming alveolar-like spaces, the central ones of which correspond to the shrunken blood-vessels. The nerve sheaths are fatty, granular, and in places covered with small concretions of lime. In various places staining is seen, this arising from the colouring matter of the blood; calcareous deposits of round, elliptical, cylindrical shape are also seen in the tissue of the pulp (figs. 252 and 253).

In a communication to the *Journal of the British Dental Association* for March, 1892, Mr. Hopewell Smith described and figured a specimen of degeneration which he termed fibroid. He said, "The pulp seems to consist of retiform connective tissue containing

large alveolar spaces, with here and there long cylindrical cavities, all having extremely thin walls. The dentinal surface of the pulp is occupied by a more highly defined appearance. Rows of

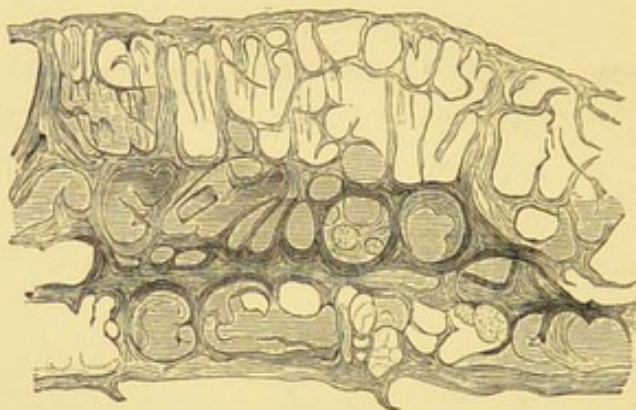


FIG. 252. (Wedl.)



FIG. 253. (Wedl.)

long thick fibres of various shapes and sizes, some bifurcated, others plain, and again some possessing fibrous offshoots, are here distinctly seen attached to, and in places detached from, the

dentine." Degenerate odontoblasts are clearly visible on the edge of the pulp. In referring to the appearance of the transverse section of his specimen he states that some of the vacuoles are circular, but he does not consider them to be bloodvessels, because they do not possess distinctively characteristic walls, nor

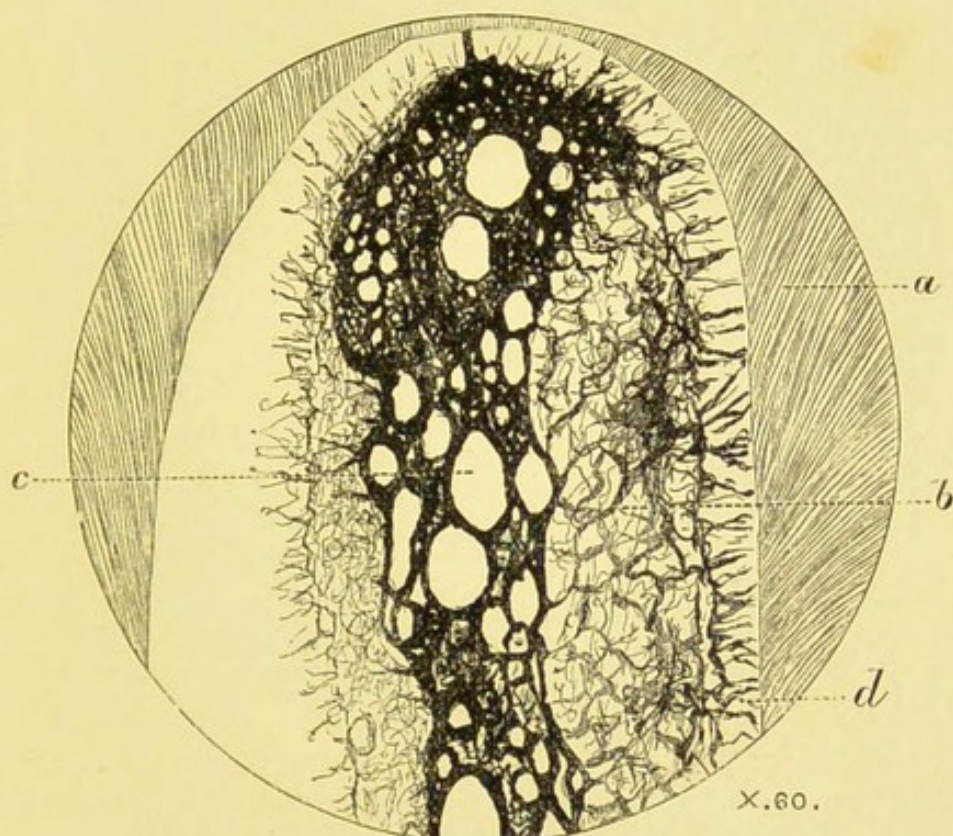


FIG. 254. Fibrosis of pulp (transverse section). (a) Dentine; (b) reticular pulp tissue; (c) areolæ; (d) degenerate odontoblasts.

is calcification to be seen in them. Throughout the pulp there is a total absence of cellular elements. A condition termed "areolation" is also described by Black. In this condition the cells of the part lose their nuclei and subsequently disappear, and a development of fibres takes place. Areolar-like spaces are developed in the matrix, and the pulp completely changed in character as shown in fig. 256. It seems probable that the reticular atrophy of Wedl, the areolation of Black, and the fibroid degeneration described by Mr. Hopewell Smith, are stages

of the same condition, at any rate such an idea is suggested by the descriptions and figures given of them.

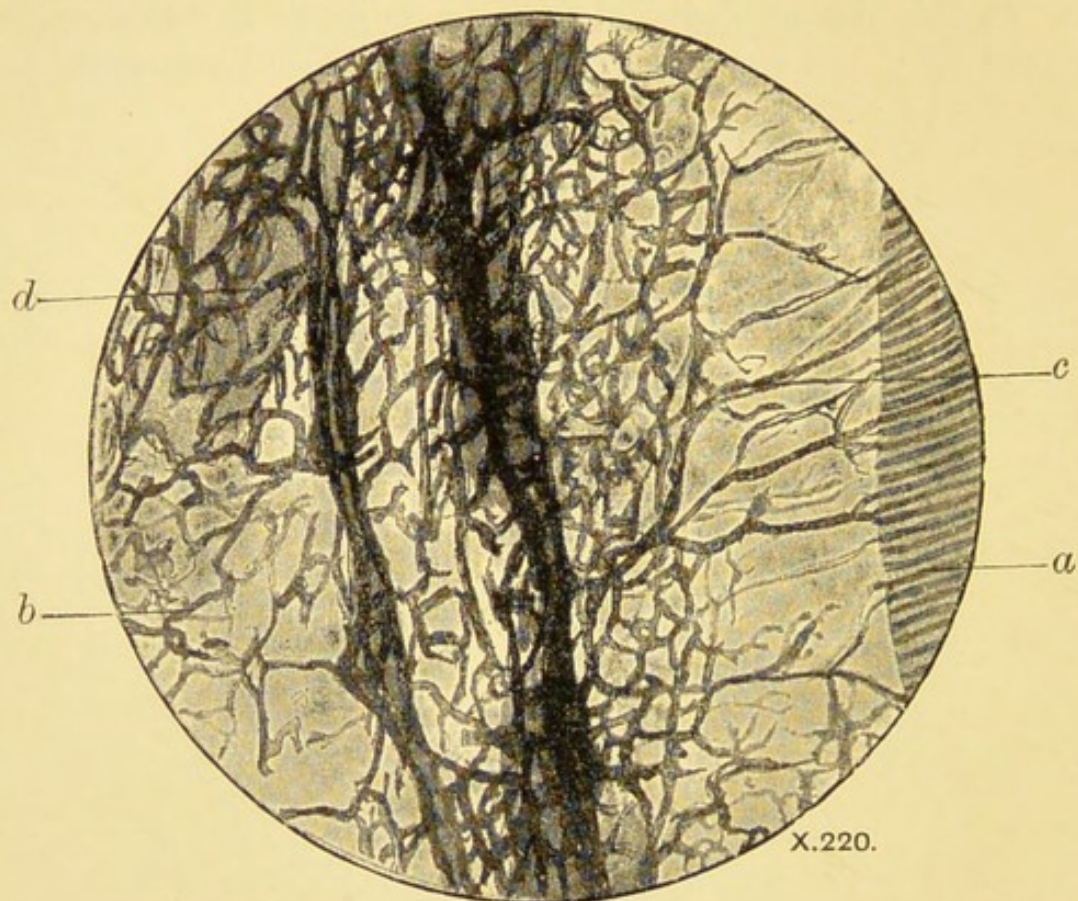


FIG. 255. Fibrosis of pulp (longitudinal section). (a) Dentine; (b) reticular pulp tissue; (c) degenerate odontoblasts; (d) fibrous cylinder.

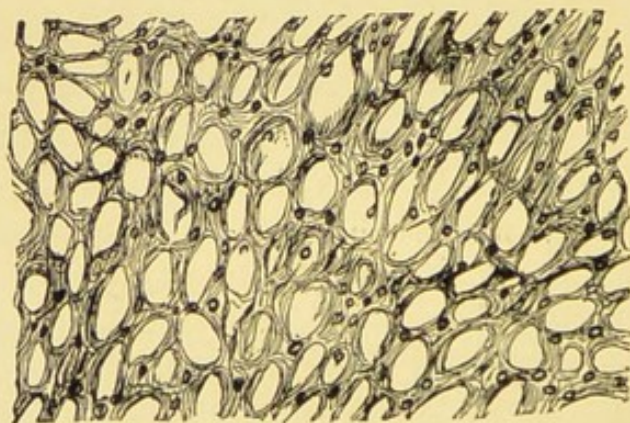


FIG. 256. (Black.)

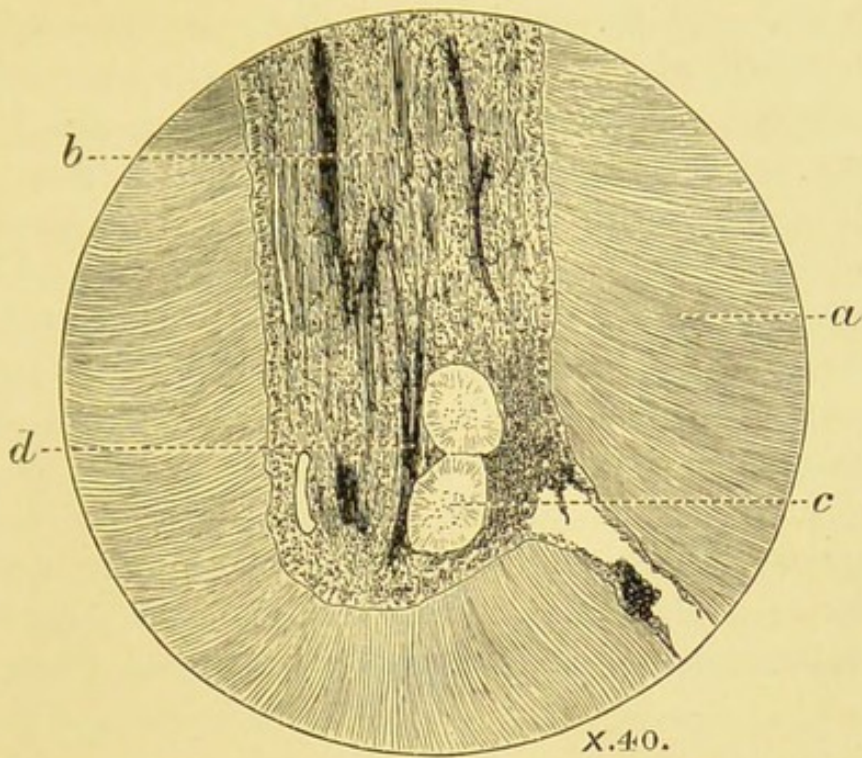


FIG. 257. Pulp nodules (longitudinal section). (a) Dentine; (b) normal pulp tissue; (c) pulp nodules; (d) nerve bundles.

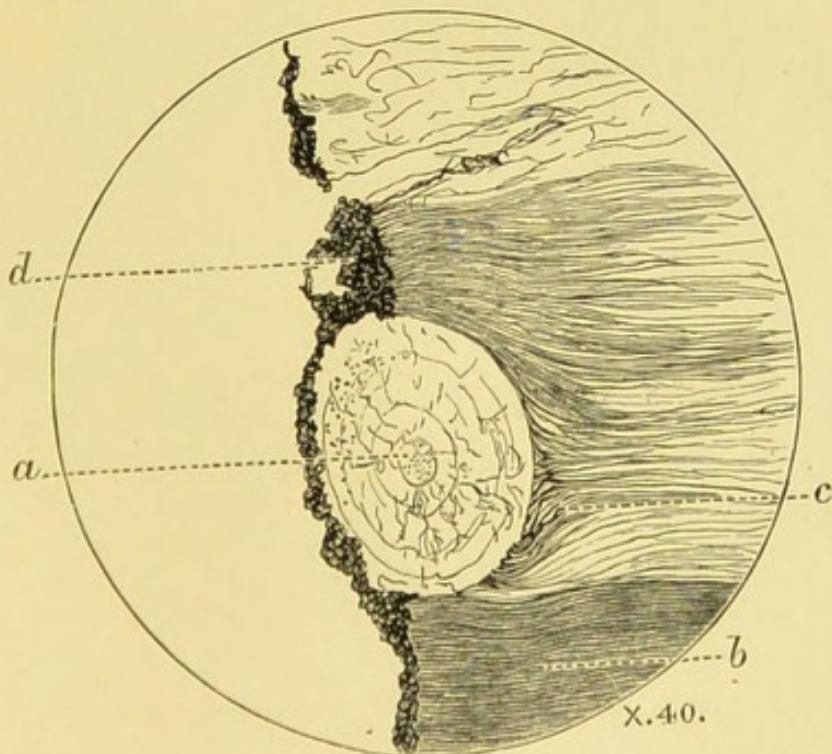


FIG. 258. Pulp stone fixed to wall of cavity. (a) Pulp stone; (b) dentine; (c) bent tubes of dentine; (d) soft tissue adherent to specimen.

"*Degeneration of the pulp into a soft, greasy mass*" is mentioned by Wedl, and he considers it to be the most advanced form of atrophy. He says that "the mass is composed merely of a dirty brownish-yellow detritus; or traces of a fibrous structure, together with clusters of stellate fatty-acid crystals, may also be identified."

Calcareous degeneration.—Calcification of and calcareous deposits among the tissues of the pulp occur in senile teeth, especially those in which there is fatty degeneration or retiform atrophy. This degeneration is common in teeth which have been long subject to attrition and abrasion, it is also occasionally seen in the apparently healthy teeth of the middle aged. In patients of gouty diathesis calcareous deposits are common. The simplest form of calcareous deposit is a small pulp nodule. On examina-

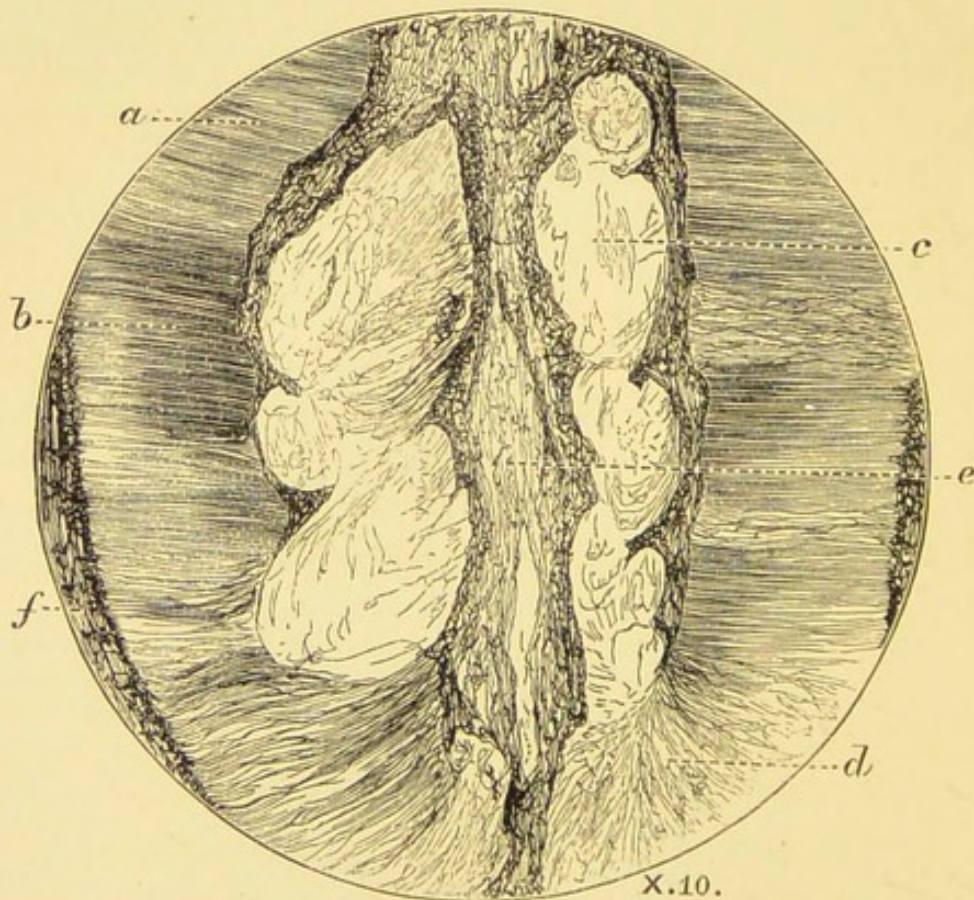


FIG. 259. Showing pulp containing a large number of calcareous deposits. (*a* and *b*) Normal dentine; (*c*) pulp nodule; (*d*) dentine containing very irregularly arranged tubes; (*e*) pulp; (*f*) cementum.

tion of the tooth after its extraction these are just visible to the naked eye, and under a low magnifying power are seen to be concentrically laminated; the central portion in some not fully calcified presents an irregular appearance. Pulp stones are formed near the periphery of the pulp, and, though developed in its tissue, eventually become included in any secondary dentine that may be formed, the dentinal tubes bending round the nodule. Fig. 257 represents two small pulp nodules from the tooth of a child fourteen years old, which was removed for irregularity. In fig. 258 the pulp stone is seen to be projecting from the wall of the canal, having become enclosed by the new formation of dentine. But pulp nodules reach in the coronal pulp of the molars a much larger size. Viewed under a very low magnifying power they are seen to be lobulated in outline and on section (fig. 260); many are apparently composed of a number

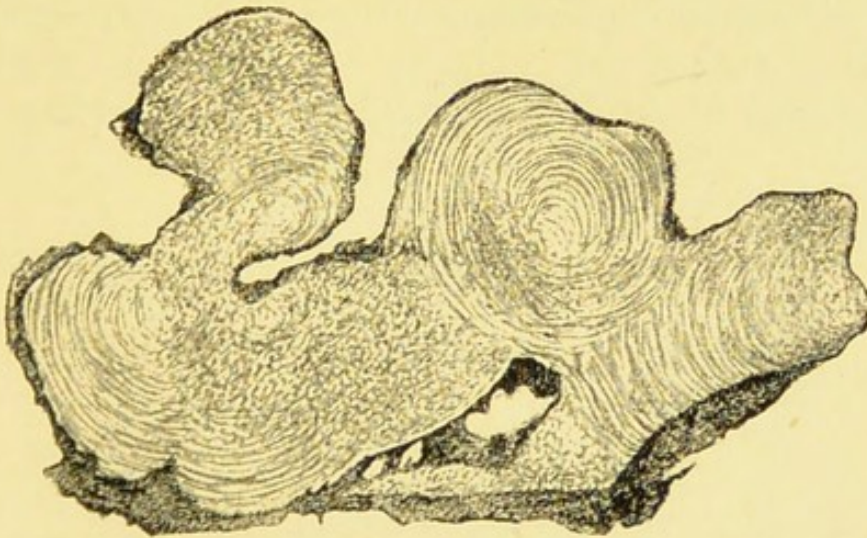


FIG. 260. Semi-diagrammatic.

of small nodules joined together by a structureless material. These pulp nodules occur amongst the tissue of the pulp, and must be differentiated from calcification of the tissues of the pulp. As before stated, Dr. Black considers that the deposits of calcoglobulin bear some relation to the formation of pulp nodules.

Calcification of the tissue of the pulp is a pathological condition frequently seen in the teeth of the old. To the naked eye the deposit differs from the pulp nodule in being non-nodulated, as a rule regular in outline and presenting a smooth surface. Microscopically the appearances vary. In some the calcified tissue element of the pulp is apparent, others appear granular

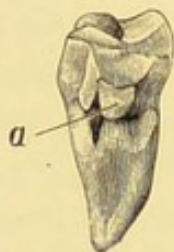


FIG. 261. (a) Calcified pulp.

on section with a few irregular tubes scattered here and there, while others exhibit virtually no structure at all. A curious form of calcareous degeneration is frequently seen, especially in the roots of molars, and is said by both Salter and Black to be a marked sign of degeneration, and like the preceding is more

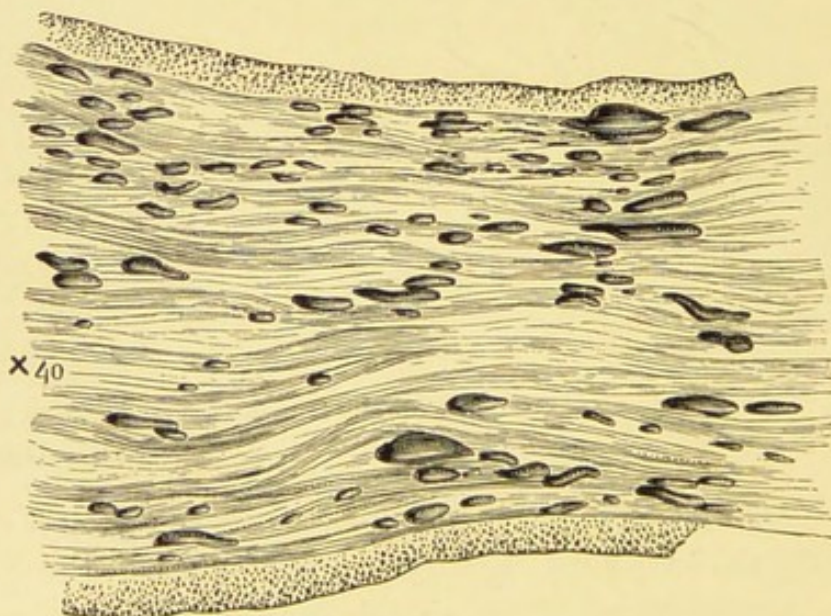


FIG. 262.

usually seen in the teeth of the old. To the naked eye the pulp is stiff, retaining its shape when removed from the canals

and returning to it when bent. To the touch the pulp feels gritty, under the microscope it is found to be fibrous in character, the cellular elements having to a great extent disappeared, while lying parallel with the fibres, and attached to them, are little cylinders of calcareous material (fig. 262). In advanced stages the cylinders coalesce, being jointed in an irregular manner. Under such conditions there is an obliteration of the cells, nuclei, and connective tissue of the pulp.

Secondary dentine.—Under this heading are to be referred the various deposits of new tissue found within the pulp cavity, but in continuity with the remainder of the tooth, in contra-distinction to calcareous material loose within the pulp chamber and having no connection with dentine. Secondary dentine occurs as a normal process in the teeth of the old, or in temporary teeth retained beyond the normal period; it also occurs whenever cause is at work which leads to pathological changes in the pulp, its formative powers under such conditions being called into fresh

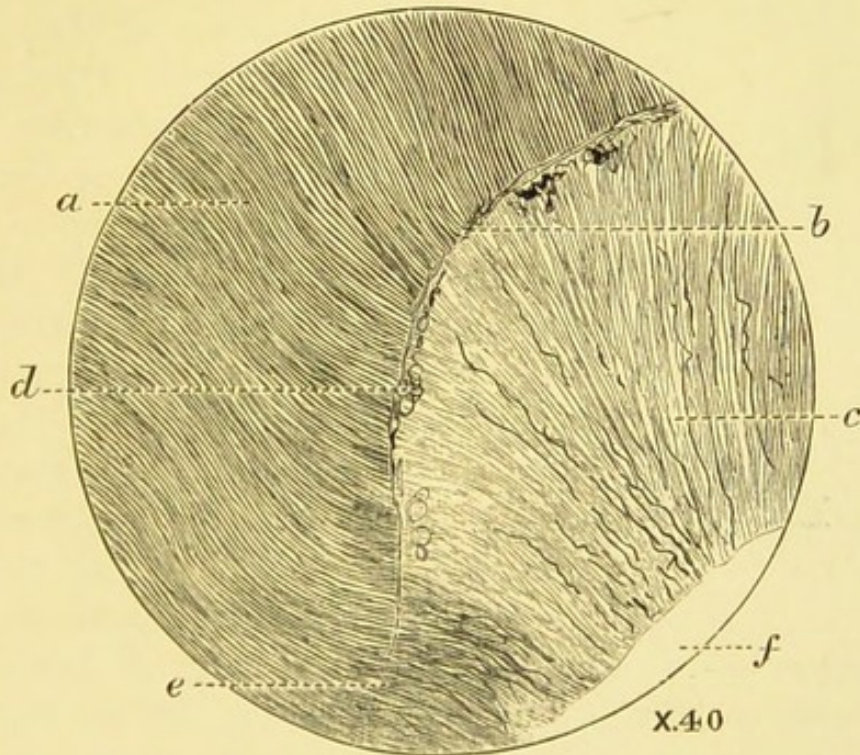


FIG. 263. Fine-tubed secondary dentine in corner of temporary molar (longitudinal section) (a) Normal dentine; (b) limit of original chamber and line of demarcation; (c) fine-tubed, but regular, section of dentine; (d) group of interglobular spaces; (e) at e tubules intermingle freely; (f) pulp chamber.

activity. The structure of the tissue formed varies considerably. When formed in old age, or in persistent temporary teeth, or when the exciting cause has been very chronic, the tissue will be approximate to normal fine-tubed dentine; a slightly abrupt bend of the tubes is all that differentiates the two tissues. In many specimens the tubes, however, are not quite so regular and plentiful as in normal dentine, but the boundary line between the latter and the secondary dentine is generally well marked. Fig. 263 is a drawing of secondary dentine occurring in a temporary molar retained until the age of thirty-five. When the

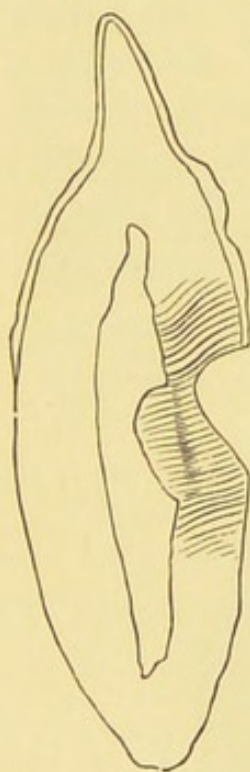


FIG. 264. Diagram showing dentine of repair.

irritant is some external agent, such as caries, abrasion, attrition, or erosion, the deposit of secondary dentine will be found to be situated about the pulp-end of the fibrils exposed. This condition has been termed by Salter "dentine of repair" (fig. 264). The dentinal fibrils in this are difficult to stain, and the whole structure of dentine at this situation seems more calcified than in other portions of the tooth. This class of secondary dentine is often structureless. More commonly a few fibres are seen continued from the ordinary dentine, and these, instead of traversing through the whole thickness of the new deposit, end in fine-pointed extremities (fig. 265). In some varieties a large number of interglobular spaces are present (fig. 266). This condition seems to be the case when the new tissue has been formed rapidly as a consequence of irritation, the result of exposure of the fibrils through caries. The

new portion of dentine, instead of having a broad base, may be pedunculated. Such masses have received the name of dentinal tumours. In cases where there has been much chronic inflammation of the pulp the tissue in the pulp cavity is often very irregular, containing lacunæ in numbers,

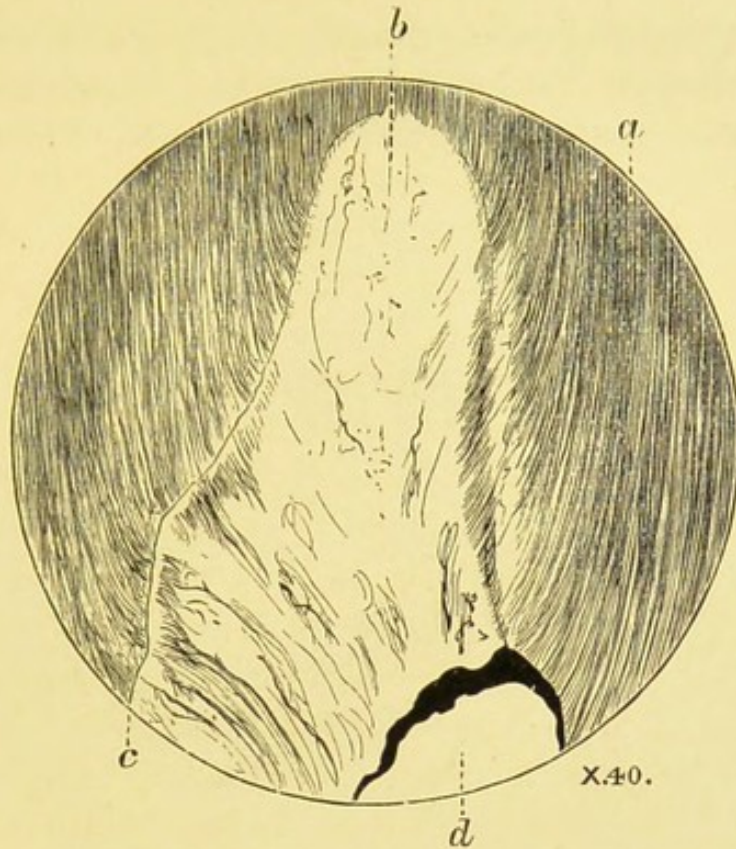


FIG. 265. Secondary dentine containing but few tubes. (a) Normal dentine; (b) secondary dentine, tubes are few and very fine; (c) line of demarcation; (d) pulp chamber.

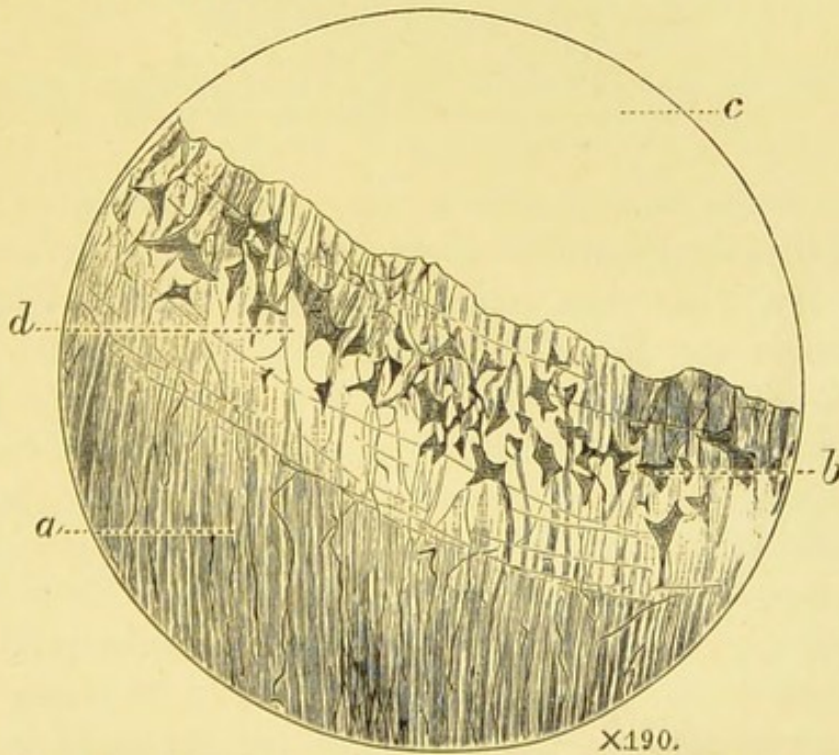


FIG. 266. Interglobular spaces in secondary dentine. (a) Carious dentine; (b) interglobular spaces; (c) pulp cavity; (d) newly-formed and irregular-tubed dentine.

somewhat resembling cementum (fig. 267). To this variety the term "osteodentine" is generally applied. Teeth in which this is present will often show marks of absorption of dentine; and

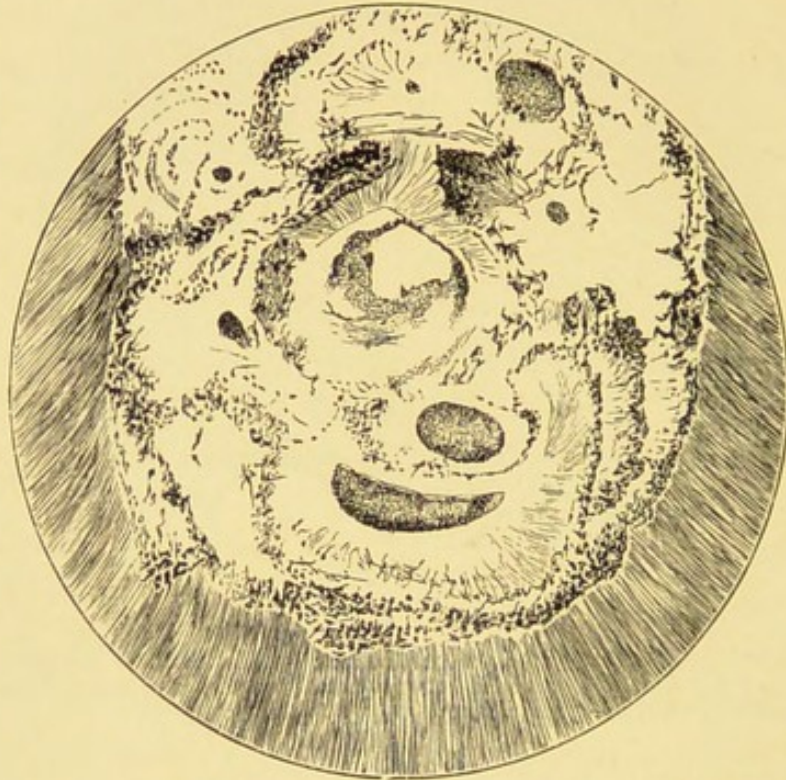


FIG. 267. To show "osteodentine" variety of secondary dentine. From a specimen in the possession of Mr. Douglas Cansh.

though in many cases there is an increase in amount of tissue, a large portion is generally found in the situation of normal dentine which has been removed by absorption. Under rare circumstances the absorbed dentine may be replaced by bone¹ (fig. 268). The tooth from which this section was taken was only partially erupted, the root apparently having been two-thirds formed, and on extraction looked as if it had been fractured; but, when examined microscopically, the appearance was found to have been produced by absorption.

Absorption of dentine.—In certain diseases of the pulp absorption of dentine takes place, more particularly in chronic inflammation and its results. To the naked eye the canal instead of

¹ *Trans. Odontological Society of Great Britain, 1893.*

tapering to the apex presents irregularities, and these, when examined microscopically, show Howship's lacunæ, and if the

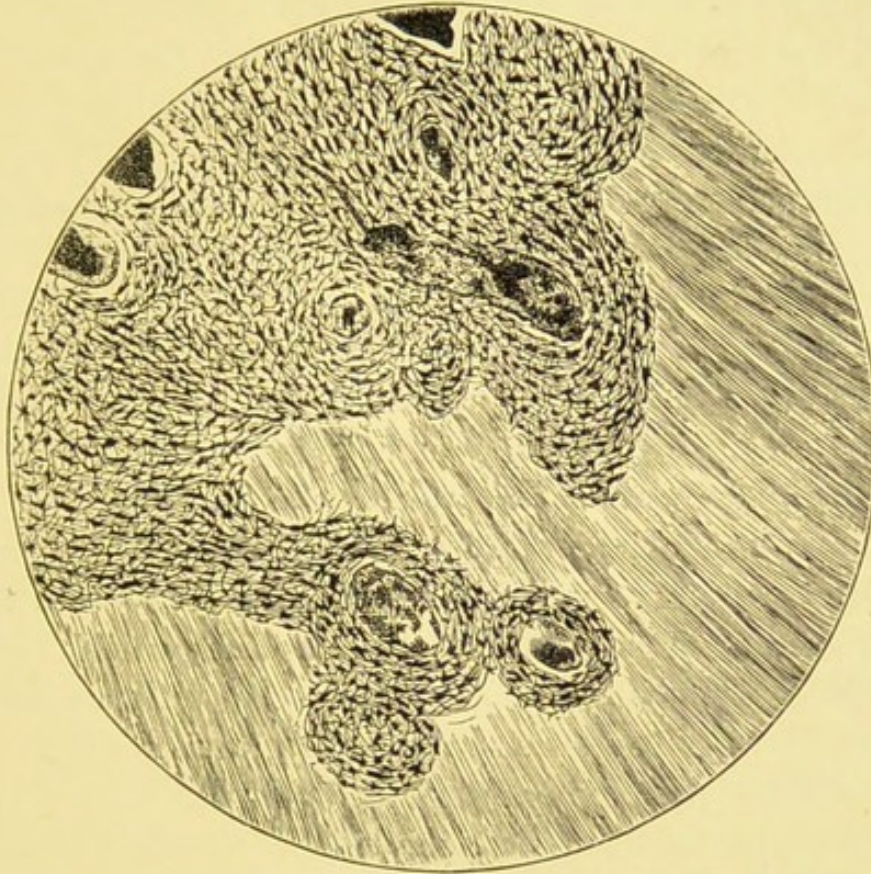


FIG. 268. Showing bone in dentine.

hard and soft tissues have been cut *in situ*, osteoclasts will be seen contained in the lacunæ.

THE TREATMENT OF DISEASES OF THE PULP.

The treatment of these cases may be considered under the following heads:—

- (a) When the pulp is not exposed.
- (b) When the pulp is exposed.
 - (1) Cases in which the pulp is still alive.
 - (2) Cases in which the pulp is dead.

(a) **When the pulp is not exposed.**—In cases of hyperæmia the cavity should be cleared of as much decay as possible, and a dressing of oil of cloves, creosote or carbolic acid, or temporary gutta percha, covered with cotton-wool and mastic, inserted for one or two days, after which the cavity should be filled with oxy-sulphate, and a strong application of some counter-irritant applied to the gum. This treatment will generally be found successful, but not always, for the pain may still be excited if hot or cold substances are introduced into the mouth. In such cases, or when suppuration takes place in the pulp chamber without any exposure, or the pulp dies from other causes, the pulp chamber must be opened and treated in a manner to be subsequently described.

(b. 1) **When the pulp is exposed and is still alive.**—The best treatment is to devitalise the pulp; some, however, prefer to endeavour to preserve it. The practical objections to the conservative method are—(1) the number of visits which the patient must make to the dentist; (2) the chances of ultimate failure, so that devitalisation has eventually to be practised; (3) the very great fear of the pulp dying at a future period.

The operation of devitalisation will be considered under the following headings:—

- (1) Devitalisation of the nerve.
- (2) Removing the nerve.
- (3) Preparing the canals.
- (4) Filling the canals.

(1) *Devitalisation of the nerve.*—For devitalisation pure arsenious acid is one of the best substances to use, though devitalising fibre or Baldock's paste is very efficacious. To perform this operation with satisfaction both to the operator and the patient, the following directions must be followed:—(1) Obtain a free exposure of the pulp; (2) place the escharotic in close contact with the pulp; (3) use only just enough material to kill the nerve; (4) insert a temporary filling over the dressing that will not press on the pulp, hence it is best to cover the dressing with

a cap ; (5) avoid escape of the arsenic or other devitalising substance. About one-sixteenth of a grain of arsenious acid should be used. It is best applied on a small piece of cotton-wool previously moistened ; this is placed in absolute contact with the pulp, and a metal cap is put over it. To keep the dressing in position, the use of gutta percha is best. It should be of the "temporary" variety. The advantages of this form of gutta percha, viz., the temporary, are that, becoming very plastic, they can be applied with very little pressure, and, softening at a low temperature, they prevent any very great thermal changes being conducted to what is often a hyper-sensitive pulp. Some operators use a solution of gum mastich or gum sandarach in preference to the gutta percha, arguing that in their application there is less likelihood of shifting the cap and dressing. A great drawback, however, to the use of these gums is that they are liable to get under the cap and prevent the action of the arsenious acid. In applying arsenious acid on the approximal surfaces with the cervical margin near the gum there is a chance of the dressing shifting during the introduction of the filling material. In such positions it is best to place a rim of gutta percha along the cervical margin first, as this allows the arsenious acid to be applied without any risk of shifting, for it will thus lie in a small pit. Fig. 269 explains this point diagrammatically. In badly shaped

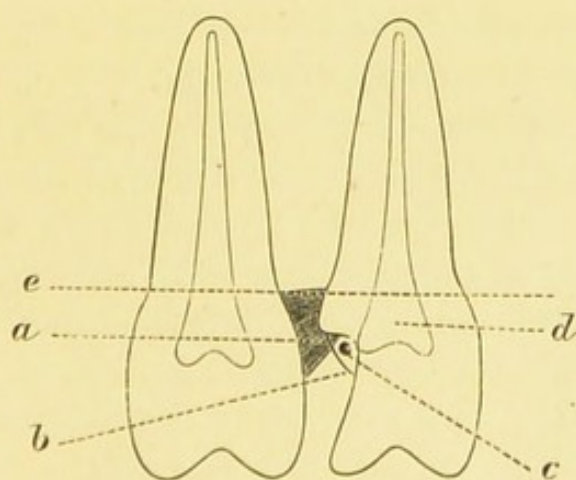


FIG. 269. (a) Gutta-percha ; (b) metal cap covering dressing ; (c) dressing of arsenious acid ; (d) pulp chamber ; (e) line indicating margin of gum.

cavities in isolated teeth, where there is a danger of the dressing not being retained, an elastic band, or silk ligature passed round the tooth will be found useful.

To prevent the pain which so often occurs during the action of arsenious acid, morphine or cocaine is sometimes mixed with the arsenic, and is of some use, but the most satisfactory method is to have a large exposure and a well made cap. The reason for the use of the latter is that during the action of the escharotic the pulp expands, the concave metal cap then leaves a space into which it can swell, and the large exposure prevents constriction. The period an arsenic dressing should be left in a tooth varies. In very young children for treatment of temporary teeth six hours should be the limit, while in adults from twenty-four to forty-eight hours is a useful time. But no harm can come from leaving dressings in for a longer period, provided that they are in teeth of which the apical foramen is closed. In teeth, the pulps of which are chronically inflamed, it is as well to leave the dressing in for at least four days, as these teeth are often extremely troublesome to devitalise. After removing the dressing of arsenic it is a good plan to insert a dressing of tannic acid for a few days. The tannin hardens the pulp and renders its removal easier. Dr. Harlan recommends also after removing the arsenic that the cavity should be swabbed out with peroxide of iron, as this unites with the arsenic to form an insoluble compound and so prevents continuance of action. It may happen that a small piece of nerve tissue remains alive near the apex of the canal and gives great trouble. When this is the case it is better to kill this by touching it with a little strong nitric acid applied on a wooden point rather than by the use of arsenic. Great care must be taken to distinguish this small piece of nerve from a large apical foramen; and if any doubt exists it is better to treat it as though it were a large apical foramen, for the escharotic treatment might lead to inflammatory trouble around the apex.

If care be not taken to carefully seal up the arsenious acid in the cavity it may leak out, causing sloughing of the gum, with, in bad cases, necrosis of the margin of the bony socket. When this

accident, viz., passage of the arsenic on to the gum, occurs, it is best treated by gently scraping away the sphacelated tissue and applying some carbolic acid to the surface thus left. Should necrosis occur, it must be treated in the manner described in the chapter on that subject. Arsenious acid, if left too long in a young tooth, or if applied high up the canal, especially if the foramen be large, may lead to periosteal trouble and necrosis of the whole socket of the tooth. If the arsenious acid dressing is swallowed by the patient, no troublesome symptoms need be feared, as the quantity generally used for the tooth is too small to give rise to toxic symptoms, although cases have been recorded of arsenical poisoning having followed this accident, or even the use of a single arsenic dressing.

The local action of arsenic is to cause hyperæmia, this being followed by dilatation of the vessels, and eventually by thrombosis, leading to gangrene of the pulp, a process similar to that occurring when the arsenic passes into the gum.

(2) *Removal of the nerve.*—In the removal of the nerve, two points require attention. Firstly, the extracting instrument should not pass through the apical foramen, and, secondly, all the nerve must be removed, if possible removed in one piece. This latter manœuvre may frequently be accomplished if (a) free access is obtained to the canals by enlarging the cavity so as to obtain a direct, or nearly direct, line with the axis of the root. In some instances in front teeth, it is inadvisable to enlarge the cavity for this purpose, but to drill straight into the pulp chamber from the lingual surface, as this avoids cutting away a large amount of healthy tissue. (b) If care is taken not to rotate the extracting instrument until it is at the apex, so allowing it to cut off the nerve there. For extracting the nerve barbed instruments are generally used. When removing a large pulp, such as that of a central incisor, the single hooked "Donaldson" is extremely useful, but for first bicuspid and small canals in other teeth the fine multiple barbed instruments are best. In using the multiple barbed instrument, previously to inserting it, bow the instrument slightly, as this allows the

nerve to be more easily entangled. In using nerve instruments insinuate them up the side of the canal until the apex is reached, then turn them lightly round three or four times before attempting extraction. Attention to these points, which seem trifling, will generally result in the pulp being removed in one piece. Directly the pulp is removed, a wisp of cotton-wool dipped in some antiseptic should be passed up the canals.

(3) *Preparation of the root canals for filling.*—There are two courses adopted by operators with regard to the preparation of the root canals, one the enlarging of the canals, the other filling them without enlarging them. If the nerve is completely removed the canals cannot be in a better condition as far as asepsis goes, even when they are enlarged, and the fact that the canals in nearly all teeth are quite large enough to admit of easy filling, also tells against any artificial enlargement, besides, there is a danger, in drilling, of pushing septic material through the apex. A filling can be inserted that will reach the apex of the canals without drills; their use, however, may at times be recommended, thus they are extremely useful for opening up the orifice of root canals, and in some instances for enlarging them.

The treatment of the canals.—After removal of the pulp, all bleeding should be stopped, and the root canals should as far as possible be dried with cotton-wool. It is then advisable to pass up a wisp of cotton-wool dipped in a solution of corrosive sublimate (1 in 500) in absolute alcohol; this dehydrates the tissues, and renders them aseptic. The canals should then be thoroughly dried by means of hot air from an ordinary chip syringe, or by the electric or thermal cautery. These means will dry the greater part of the canal, but for the portion near the apex, a root canal drier will generally be necessary. When the canal is thoroughly dried, the root filling is to be inserted.

Before using root drills it is well to pass up the canal a fine unbarbed "Donaldson," on the shank of which is a small piece of rubber; this will indicate roughly the direction of the canal and

its length, the latter being marked by the shifting of the piece of rubber. The drills should be used on the engine, and the Gates Gliddon type is preferable. Care should be taken to see that the drills are spring tempered, and that, when in use, they are in a direct line with the root to be filled. They should be used with a "touch-and-go" movement, and persuasion not force used, the pointed head of the drill guiding the instrument along, frequent withdrawals being made to allow the removal of débris, and the depth to which the drill has gone should be tested by the "Donaldson." It is important to start with a small drill at first, substituting larger ones from time to time. The first drill should reach the apex, the larger ones should, however, not reach quite so far. The after treatment of the canals is essentially in all respects the same as that previously described. The use of Gates Gliddon drills sometimes is attended by accidents, and it may be well to explain the causes of them and their treatment. Mr. George Seymour has well arranged these causes:—

(1) The breaking of the drill in the canal. Causes—(a) The use of rusty drills (this is best avoided by keeping the drills in oil); (b) pushing the drill up too rapidly, causing it to become fixed; (c) through not having a sufficiently large opening into the cavity, and so trying to work the drill round the corner.

(2) Perforation of the apex. Caused by using a small drill with too much force.

(3) Perforation of the side wall of the fang, and with it more or less injury of the periodontal membrane. Causes—(a) Passing too large a Gates Gliddon drill up to the apex; (b) cutting away too much of one side of the root (as in pivoting); (c) enlarging the canal too much; (d) lastly, the dangerous practice of working drills round the corner, especially when there is too much injudicious force employed to make them advance.

If the operator has the misfortune to break the drill, endeavours must be made to remove it. The first thing to do is to enlarge the canal and to endeavour to catch hold of the broken drill with a pair of forceps, those specially designed by Mr. George

Seymour for this purpose will be found serviceable. Should this procedure be unsuccessful, an Arrington flexible crochet hook should be passed up the canal, and an endeavour made to hook the broken drill down. Cotton-wool at the end of a broach to entangle the drill may be tried ; but if repeated efforts only lead to failure, one of two courses is to be recommended. The first is to leave it *in situ*, and the other to rust it out by applications of iodine. The first course is the better ; the second course seems to make matters worse, the iodine weakening the shaft, so that it breaks at the least touch, leaving the head still *in situ*.

With regard to "perforation of the apex," the best treatment is to syringe the canal with a solution of Hydrarg. perchlor. 1-1000, treating it in the usual way, and, when filling, taking especial care that the filling material does not protrude through the foramen. Perforation of the side of the canal nearly always ends in loss of the tooth. An attempt, however, should be made to save the tooth, and it is best in these cases to perform rhizodontrophy, rather than fill the root while there is a danger of the root-filling acting as an irritant.

(4) *Filling the canal*.—For filling root canals, a large number of different materials are used, the chief ones being gutta percha, osteoplastics, wood, wire, wax, celluloid, gold, tin, or lead. In filling a root, the chief point is to thoroughly plug the apex ; and if this is done, it is not of much importance what is inserted into the remainder of the canal.

Gutta percha is an excellent material, and is perhaps the most universally used. It is sold ready for use by the various depôts. The method of employing it is as follows :—With cotton-wool wound round a broach, introduce some chloro-percha up the root or root canals, using a slight piston-like action ; then take a gutta percha point, and pass it up the canal as far as the apex ; by the side of this introduce one or two more as may be required ; they should then be left *in situ* for about half a minute, after which, with suitable instruments, they are condensed and thoroughly packed into the canal. On introducing the first piece a slight twinge of pain will occasionally be felt. This

generally indicates that the point has passed through the apex, from the gutta percha point being too small. To meet this difficulty, remove the gutta percha and cut off the end, and re-introduce. It is a little troublesome at times to hold the points of gutta percha in the forceps in the suitable position; but if the points of the latter are slightly warmed, the gutta percha adheres to them, and can be easily carried to any situation. The canals being filled, the remainder of the pulp chamber should be filled with osteoplastics; for the reason that if anything goes amiss with the filling in the cavity, the osteoplastics will protect the gutta percha in the canals, and prevent it becoming septic.

Canals filled with gutta percha answer admirably, and it is found quite easy to get it to the apex. The only argument of any weight urged against its use is that it is liable to become septic; but if the canals are cleansed properly and filled, it is difficult to see how the sepsis is brought about.

Wood is useful in places which are fairly accessible, and this like the preceding can be obtained from the depôts ready for use. The length of the canal having been obtained, a peg is selected which fits loosely in the canal. The wood is then dipped in chloro-percha three or four times, and allowed to dry. A little chloro-percha should be passed up the canal, after which the peg is forced into position, a rotatory motion being used which, when the peg is tight, causes it to twist off. An argument urged against wood is that it is liable to absorb moisture, and, so expanding, cause splitting of the tooth. To avoid any chance of this, the points should be well soaked in paraffin during the process of manufacture.

Gold and copper wire are used in much the same way as wood, the length of the canal being notched upon the wire, and when *in situ* the surplus cut off. With wire there is greater certainty of filling the apex than with any other material, but its use requires care, as it is possible to push the wire through the apex, and so excite inflammation of the periosteum.

Equal parts of iodoform and wax are used by many operators,

but their application to back teeth is not so easy as is generally supposed. They are thus used :—Loosely wrap a wisp of cotton-wool round a broach, then on a spatula or some such instrument melt a portion of iodoform and wax, pass the broach with the cotton-wool through this and insert quickly, as the material rapidly sets and is then difficult to manipulate. As a root-filling iodoform and wax are not to be relied upon, as in many cases the wax seems to disappear entirely from the canal. *Osteoplastics* mixed thin, and applied in the same manner as the foregoing, are useful fillings, but some operators prefer to use the osteoplastic without the cotton-wool. *Gold, copper, amalgam, celluloid, plaster of Paris, paraffin, shellac, etc.*, have all advocates, and in the hands of the individual operator appear to give satisfactory results.

Teeth with single roots are more easily treated than those with multiple ones ; and of the latter the buccal roots of upper molars, the anterior roots of lower molars, and occasionally the roots of the upper first bicuspid will be found troublesome to treat. In the first upper bicuspid search should be made for two canals, for they are nearly always present, although the bifurcation may take place high up. The buccal roots of the upper molars are often small and irregularly placed, the anterior one being situated near the anterior external angle of the pulp chamber. When these canals are so small that they will not admit a fine nerve instrument they are better left alone, as they rarely give any subsequent trouble. It should also be remembered that these teeth may have four root canals. In the second upper molar it is not uncommon to find the buccal and the palatine canals fused together. This must be remembered and care taken to recognise it, as under such conditions there will be only two canals—the one being large and flattened, and the other small and round. In the third molar only one root canal may be present, due to fusion of the roots into one mass, but cases are sometimes seen in which there is an excess number of roots. The anterior root of the first lower molar has nearly always two canals, situated internally and externally. These are generally

quite small, and should, under such circumstances, be left alone. The posterior is the important canal, and can easily be found and treated: in rare cases this root is bifid, and then presents two root canals.

(b. 2) Cases in which the nerve is exposed and has died.—We have already seen that destruction of the pulp may arise from a variety of causes, which act by producing suppurative inflammation or gangrene. The treatment of these conditions will now be considered. If the contents of the pulp cavity in which the nerve is dead be examined they will be found to vary according to the pathological conditions that have caused the death of the pulp.

- (1) The gangrenous pulp may be present in its entirety, or it may have undergone disintegration, leaving the contents moist and in a sloughing condition, which in most instances terminates in complete disorganisation.
- (2) The contents may be dry and granular.
- (3) The pulp tissue may be transformed into a cheesy mass, probably due to a form of fatty degeneration. This condition is found in those pulps which have been "capped," or have died under fillings.

Pulpless teeth may be divided into—

- (1) Those uncomplicated by periosteal trouble;
- (2) Those complicated with periosteal trouble, which may be sub-divided into those in which (a) an acute abscess exists, (b) a chronic abscess exists without a sinus on the gum, and those (c) where a sinus is present.

The *treatment* of pulpless teeth is one of great practical importance, and much diversity of opinion exists upon the exact mode in which this should be carried out. There are two methods advocated: in the one the canals are cleansed, rendered aseptic, and filled at one sitting; in the other the canals are dressed frequently before filling.

The first method, or *immediate root filling*, is in the great majority of cases the best to adopt, and should be carried out as follows:—The cavity must be cleared of all decay, the pulp chamber opened up freely, and both syringed out with warm

water. The rubber dam, or some other method for excluding saliva, should be used, and the cavity, having been dried with cotton-wool, should be swabbed out with Hydrarg. perchlor. 1-500. With hooked nerve extractors the canal should be carefully freed of débris, and in carrying out this part of the operation too much care cannot be taken to prevent septic material being forced through the apical foramen, and this can be accomplished by gradually proceeding from the orifice of the canal towards the apex. The canals should then be syringed out with some anti-septic solution injected by a hypodermic syringe, or introduced on a wisp of cotton-wool; if the latter is used, it must be with a rotatory rather than a pumping action. As germicides, corrosive sublimate and hydrogen peroxide are useful, each having ardent advocates. The canals can then be enlarged if necessary, and, following this, should be thoroughly dried with some form of cautery. A solution of perchloride of mercury and absolute alcohol should be passed up and left in for one or two minutes, the canal finally being filled with either gutta percha, wood, or other filling.

Those who do not pursue the immediate method adopt practically the same mode of procedure, but, instead of filling the root at one sitting, insert a dressing, changing it on several occasions until the canal is considered aseptic. In teeth with dead pulps, where there is no periosteal trouble, the immediate treatment can be carried out with success. Where a sinus is present upon the gum the same treatment can also be adopted, and some mild irritant, *e.g.* carbolic acid 1-20, or tincture of iodine, etc., should be forced through the sinus, as this accelerates healing, but in the majority of cases good results may be obtained by immediate root-filling without injecting the sinus. When a chronic abscess without a sinus is present the treatment is exactly the same as the preceding, immediate root-filling being by far the best method. If peroxide of hydrogen is the germicide employed, it should be used until all bubbling due to the evolution of gases ceases. In many cases, if the swelling over the gum does not subside, it is advisable to open freely through

the gum and alveolus, packing the cavity with antisepticised lint, in order that the latter may heal by granulation. The diagnosis of a blind abscess is not always easy, the symptoms present generally being slight swelling at the region of the apex of the root, with tenderness on pressure over that part, and with accompanying slight pain upon percussing the tooth.

In connection with the treatment of teeth in which the pulps are dead, the operation of *rhizodontrophy* must be considered. By this is meant the drilling of a small hole from the periphery of the tooth into the pulp cavity, the latter, with the canals, being left unfilled. It is an operation which should only be employed as a last resource, and is indicated in such cases as the following:—

- (1) Dead teeth in the temporary dentition.
- (2) When it is impossible to clean the pulp canals out thoroughly.
- (3) When the root of the tooth is partly absorbed.
- (4) When acute inflammation of the periosteum has supervened from death of the pulp due to a filling which would be difficult and painful to remove. In these cases a hole should be drilled through the filling.

When in the three first cases it is intended to perform this operation, it should be carried out as follows:—With a spear-head drill a hole should be made, starting just under the margin of the gum, into the pulp cavity. For preference this should be made from the lingual side, as it is easier to keep the hole patent in this position. A cap should then be made to cover the pulp chamber, and a filling inserted in the usual manner. The patient should be instructed to keep the hole free from débris, and it is useful to give them for this purpose an unbarbed Donaldson's bristle.

Bleaching teeth.—Devitalised teeth often undergo a process of discoloration, which may vary from a dull bluish hue to a dark plum colour. Teeth in which the pulps have died from the effect of such injuries as blows seem to discolour most, and the teeth of the young are more affected than those of adults. The

change in colour is said to be due to the passage of the colouring matter of the blood into the dentinal tubes. Staining of the tooth structure may also, as already referred to under amalgam, be due to the use of that material as a filling.

To remedy the unsightly appearance of discoloured teeth, the process of bleaching is recommended. The results obtained are not, as a rule, satisfactory, but this is said by Dr. Truman (*American System of Dental Surgery*, vol. ii. p. 297) to be due to defective manipulation. Amongst the agents suggested chlorinated lime seems to be the most serviceable, and it is advocated by Dr. Truman, who adopts the following method:—Cleanse the canals and cavity of all softened and decayed dentine, and fill the upper third of the canal with some form of root-filling. The remaining portion of the canal and the cavity should then be washed with a solution of bicarbonate of soda, borax or ammonia, as these will remove all fatty material. Another washing with distilled water is then used, and the rubber dam applied, the cavity being thoroughly dried. The chlorinated lime is then rapidly packed into the cavities, by dipping the instrument in a 50 per cent. solution of acetic acid, and taking up the lime upon the moistened instrument, the cavity being sealed with gutta percha or osteoplastic. At the end of two or three days the dressing of lime is renewed, and this repeated until the tooth is bleached. It is most important to use distilled water at all times for syringing, and to avoid the use of steel or iron instruments. The acetic acid is to set free the chlorine from the chlorinated lime. The bleaching of the tooth will be first observed near the cutting margin, that portion of the tooth towards the neck occupying a longer period. When the tooth is brought into a satisfactory condition the remaining part of the canal must be filled with oxy-chloride, and the walls of the cavity also lined with this material before inserting the filling. The reason for using the oxy-chloride is that the tubuli are filled with decomposable material, and the oxy-chloride, being a more powerful antiseptic than the oxy-phosphate, is better.

Dr. Kirk adopts much the same plan as the above, using a

mixture of 100 grains of sodium sulphate with 70 grains of boracic acid as the bleaching agent. Dr. Harlan recommends that the rubber dam should be applied, and the cavity swabbed out with peroxide of hydrogen and then dried. Chloride of aluminium is moistened with peroxide of hydrogen and allowed to remain in the cavity for five minutes, after which the cavity is syringed with a solution of bicarbonate of soda and dried. This method, he claims, gives excellent results.

As mentioned previously, attempts at bleaching are often disappointing, and in the majority of cases it is better to remove the discoloured dentine as far as is safe, and then to fill or line the cavity with some light-coloured osteoplastic.

CHAPTER IX.

DISEASES OF THE DENTAL PERIOSTEUM.

PERIODONTITIS, pericementitis, or dental periostitis are the names given to indicate an inflammation of the alveolo-dental membrane. The pathological changes which take place in the tissue are practically the same as those observed in any other tissues in a state of inflammation, and may be briefly summed up as follows:—At the seat of irritation the vessels become dilated, allowing an increased flow of blood to the part, and hence leading to congestion in the capillary circulation; the dilatation is followed by a slowing of the current, which in turn is followed by the condition known as stasis. During these latter changes leucocytes escape through the vessel walls into the surrounding tissue accompanied by an exudation of serum, these changes causing a swelling of the parts and pain, through pressure on the nerve endings.

Periodontitis may be either general or local. By the former is meant an inflammation attacking the sockets of several teeth, and is generally due to a constitutional condition; by the latter an inflammation localised to one tooth, having generally for its cause a local origin. As the local form is the one generally met with in dental practice, it will be described first.

Local periodontitis may be either (*a*) acute or (*b*) chronic.

(*a*) *Acute local periodontitis*.—The usual cause of this form is escape of septic matter from the pulp canal through the apex of the root. Still, it may have other origins, such as an injury from

a blow upon the tooth; but this is also generally accompanied by destruction of the pulp, or it may arise without apparently any cause (idiopathic). Like all other acute inflammations it may terminate by resolution, by passing into the chronic form, or by suppuration, which is the usual termination.

The symptoms of an attack of acute periostitis terminating in suppuration may roughly be divided into four stages. In the first stage the patient notices that the tooth is somewhat uneasy, and that there is a certain sensation of tension when the tooth is being slightly raised at this period, but biting brings relief. In the second stage, the tooth will be still further raised, the gum around being swollen and tender, the free margin assuming a deep red colour. A dull, constant, gnawing pain will be present, and should the patient bite on the tooth, relief will no longer be afforded, but intense pain will be caused. In the third stage, the swelling increases accompanied by the still dull, constant pain, which has by now probably become throbbing. In the last stage, the swelling becomes more defined, being generally more prominent at one part; in other words, the abscess points—this latter condition being accompanied, as a rule, by a mitigation of the pain. The places where an alveolar abscess points will be dealt with more fully under that heading. The interpretation of these local symptoms is simple. In the first stage, the vessels of the periosteum are in a condition of congestion, and the alveolo-dental membrane engorged in consequence, no exudation into the surrounding tissue from them having taken place; hence the slight raising of the tooth in the socket, and the fact no doubt that pressure brings relief, since it forces the blood from the dilated vessels of the membrane. In the second stage, the inflammation having advanced, the vessels are found in a condition of stasis, with the surrounding tissue infiltrated with inflammatory exudation; hence the increased raising of the tooth in the socket, and the fact that pressure cannot bring relief but increased pain, because the vessels can no longer be freed of their surplus supply of blood, and each act of mastication only increases the pressure on the hypersensitive

nerves. In the third stage, the escaped leucocytes and exuded serum increase in quantity and the cells undergo degeneration or conversion into pus cells, and as long as this is contained in hard and unyielding walls the pain is naturally intense. In the fourth stage, the pus, having made its way through the bone into the loose cellular tissue, accounts for the rapid increase in size of the swelling, the mitigation of pain being due to the relief of tension upon the nerve endings. Acute periostitis is generally attended by a certain amount of febrile disturbance, such as is common with most inflammations, including increase in temperature, furred tongue, especially on the side next to the offending tooth, scanty urine, hot skin, loss of appetite, etc. The treatment may be divided, as the treatment of inflammation in any other part of the body, into general and local. The general treatment consists in the administration of saline purgatives, with the view of reducing the blood pressure, and in many cases this should be followed by a tonic treatment. The necessity of attending to the general condition of the patient cannot be too strongly impressed; and the treatment, whether it lies within the domain of a dentist or not, is of secondary importance, provided that it is carried out. A most useful purgative to administer is the following:—

℞	Magnesiæ sulphatis,	-	-	-	gr. 60.
	Magnesiæ carbonatis,	-	-	-	gr. 20.
	Aquæ menthæ piperitæ,	-	-	-	ʒj.

M. Mitte ʒviii. Two tablespoonfuls three times a day.

As a tonic the following will, in many cases, be found useful:—

℞.	Quinine sulph.,	-	-	-	-	gr. j.
	Ac. sulph. dil.,	-	-	-	-	℥. v.
	Ferr. sulph.,	-	-	-	-	gr. iv.
	Magn. sulph.,	-	-	-	-	gr. x.
	Sp. chlorof.,	-	-	-	-	℥. x.
	Aquæ,	-	-	-	-	ad ʒj.

M. Mitte ʒviii. Two tablespoonfuls three times a day.

Local Treatment.—If the tooth cannot be saved it should be removed at once. An antiseptic mouth wash should be ordered

in these cases, and it is often advisable to apply some sedative to the socket, which is often inflamed, as pain is very frequent after extraction. A useful application is phenate of soda. If conservative treatment is adopted, the measures used will depend largely upon the stage of inflammation reached. Should the case present itself in the first stage of inflammation, viz., when the bloodvessels are engorged, much relief may be given by local depletion, by means of incisions with a scalpel, or by the application of a leech; for the relief of periodontitis, in addition to these measures, counter-irritants should be applied to the gum over the root. Equal parts of tincture of iodine and tincture of aconite is a remedy used by many; but inasmuch as the tincture of iodine is weak, the liniment of iodine will prove more efficient.¹ Capsicum plasters are also useful, especially those recommended by Dr. Darby; the advantage of these is that they are efficient, and the patient can apply them more easily than the tincture of iodine.

If the blood is in a condition of stasis and exudation has taken place into the tissues, local depletion and counter-irritants will still be valuable, and warm fomentations should be applied in the mouth, and on no account should the fomentation be applied externally. Directly pus is formed measures must be taken to bring about its evacuation. To do this the patient should be recommended to continually poultice over the situation of the tooth with hot raisins or figs, etc., and as soon as the abscess has made its way through the alveolar wall it should be incised with a Syme's or Paget's abscess knife.

As soon as the operator is able to operate upon the tooth the canals should be cleared and treated in the usual way. In all cases of periodontitis due to the spread of inflammation from the pulp to the periosteum, while the inflammatory products (pus, etc.) are pent up, an exit should be established by drilling into the pulp chamber. [See the preceding chapter.] This treatment will give immediate relief, and when the inflammation of the periosteum has subsided the tooth can be treated in the usual way.

¹ Lin. iodi. Tinct aconiti. Chloroform. āā ʒij.

Chronic local periodontitis is a chronic type of inflammation limited to the socket of a single tooth and more frequently attacks pulpless teeth. It may be also met with in replanted teeth, and in those which are abnormally antagonised. Chronic periodontitis may start near to the apex of the tooth or to the free margin. In the former case, it is generally due to some abnormal condition of the root canals; but in the latter, it may be caused by tartar, ligatures, etc. Too rapid wedging of a tooth will often result in a certain amount of more or less prolonged chronic inflammation of the periosteum. It is noticed that teeth operated on by regulating appliances seem predisposed to chronic inflammation, while syphilis, struma, anæmia, and rheumatism act as predisposing causes of chronic periodontitis.

In teeth long affected by chronic periodontitis, exostosis of the cementum (fig. 270) and, at other times, absorption more or less extensive, occur (fig. 277). When teeth which have been the subjects of chronic periodontitis are examined after extraction, the periosteum is seen to be thickened or of a darkish colour, to emit an offensive odour, and, under the microscope, exhibit the changes commonly seen in other chronically inflamed parts. The symptoms of chronic periodontitis differ, and depend much upon the cause of the mischief. If some trouble at the apex has originated the inflammation, it will be found that the tooth is slightly elongated and loosened, the gum around somewhat swollen and congested, and pressure on the tooth will give rise to pain. This condition may be constant or intermittent, and, if aggravated, leads ultimately to the loss of the tooth. In many of these cases the inflammation results in suppuration and chronic alveolar abscess. When, however, the inflammation starts at the margin of the alveolus, and is due to ligatures, elastic bands, etc., the condition is somewhat different; the tooth will be elongated and painful, the gum reddened, and, at the same time, a discharge will generally be noticed surrounding the tooth; this discharge arises from suppuration in the alveolar dental membrane, and, if the case is left alone, results, by a process of

ulceration, in the entire destruction of the membrane. In the case of ligatures and elastic bands left on teeth this is fairly rapid; but, when due to the presence of tartar on a tooth, is rather slower.

The *diagnosis of chronic periodontitis* presents no difficulty; looseness of the tooth, tenderness on percussion, and the presence of a dull, gnawing pain being pathognomonic.

Treatment will depend greatly upon the cause of the inflammation. When starting at the gum margin, the cause should be removed; the pocket of gum around the tooth should be syringed with some antiseptic solution, followed by the application of an astringent, such as powdered tannin. Many of these cases get quite well, although in front teeth a certain amount of elongation may persist. In cases in which elongation has occurred irritation may be kept up by the opposing teeth, and in these cases either of the teeth must be shortened. If it be decided to shorten the elongated one, the patient will be spared a great amount of pain if the operator holds the tooth firmly whilst grinding it. If the cause is apical and due to the presence of septic material in the canal, the treatment consists in carefully cleansing and filling the canal. In cases where the canal is already filled and the cause of trouble is obscure, palliative treatment may be adopted, *e.g.*, the application of counter-irritants or local depletion. When the patients are liable to periodic attacks it often arises from debility. It is well to administer a purge, and follow up this with a tonic. In these cases Mr. Coleman has recommended as a local treatment the application of a saturated solution of ammonium chloride, a plan which is certainly of great use in many cases:—

R̄.	Ammon. chlorid.,	-	-	-	-	-	ʒiij.
	Aquæ,	-	-	-	-	-	ʒij.

M. Ft. applicatio. To be applied to the gum with the finger.

In obscure cases complicated by exostosis, absorption, or the presence of an apical abscess, but little can be done except palliative local measures, though some operators have practised

excision of the apices, a line of treatment which does not altogether commend itself to the authors of this manual.

General Periodontitis.—In the condition just considered, the inflammation was limited to one tooth; in that now to be referred to it involves several teeth, as well as the contiguous periosteum of the maxillary bones. This condition may be a symptom of serious trouble, and it is important that it should be recognised early. General periostitis may be due to injury, or the result of prolonged administration of mercury or of phosphorus. It may follow upon the exanthemata, and may arise from struma, gout, rheumatism, or syphilis. Lastly, it is often an early symptom of commencing necrosis or of malignant disease. The great danger of periostitis, especially if showing a tendency to suppuration, is necrosis; but this is not so likely to occur in gout or rheumatism.

The *symptoms of general periostitis* are the same as those of the local form, the pain of the rheumatic form being very marked, especially during cold, damp weather. The treatment in the acute varieties is to remove any cause that may be present, together with free lancing, or the application of leeches, and saline purgatives should be administered. If suppuration seems imminent free incisions into the gum must be made. In cases due to syphilis, iodide of potassium must be given, while those of gouty or rheumatic origin call for the general treatment of those diseases. In these latter cases the local application of tincture of iodine and tincture of camphor in equal parts will often be found to give relief. In all obscure cases, especially if not amenable to treatment, a careful examination for the presence of tumours or necrosis must be made.

Dental exostosis.—By dental exostosis or cementosis is meant an outgrowth of cemental tissue on the root of the tooth. It is produced by chronic periodontitis, terminating in organisation, and is therefore a process similar to that found in bone, viz., osteoplastic periostitis, a disease characterised by inflammation of the periosteum, terminating in a growth of osseous tissue to the periphery of the bone. Exostosis may occur in connection with

any tooth, though the molars are more frequently affected, because in these teeth chronic inflammatory trouble is often present.

The effect of dental exostosis is to alter in various ways the naked eye appearance of the root. The outgrowth may form a smooth globular swelling, which may completely embrace the apex (fig. 270), or only be present on one side. In other cases the new tissue may be irregularly placed on any part of the root, and instead of having a smooth surface may present numerous pits, the root of the tooth appearing similar to a surface covered with drippings from a candle (fig. 271). At times the whole root is completely embraced, and in some



FIG. 270.



FIG. 271.



FIG. 272.

instances the exostosis ends with a well-defined ridge at its upper limit towards the neck of the tooth (fig. 272). The addition of tissue may be so great as to cement two teeth together, the septum between these having disappeared by the process of absorption caused by inflammatory products. Extensive absorption at one part and dental exostosis at the other are at times seen in the same specimen. The smoother and more globular the character of the swelling the more continuously chronic has been the process, while the irregular deposit is due to intermittent attacks of absorption and deposition. When the tooth is extracted the periosteum will be found to be thickened, more vascular than usual, and flesh-like masses will often be seen to be adherent to the tooth.

Microscopically, the new tissue is seen to be cemental in

character (fig. 273), but it differs in some ways from normal cementum. When the deposit on the tooth is smooth and regular, the new tissue will be seen to be fairly regularly

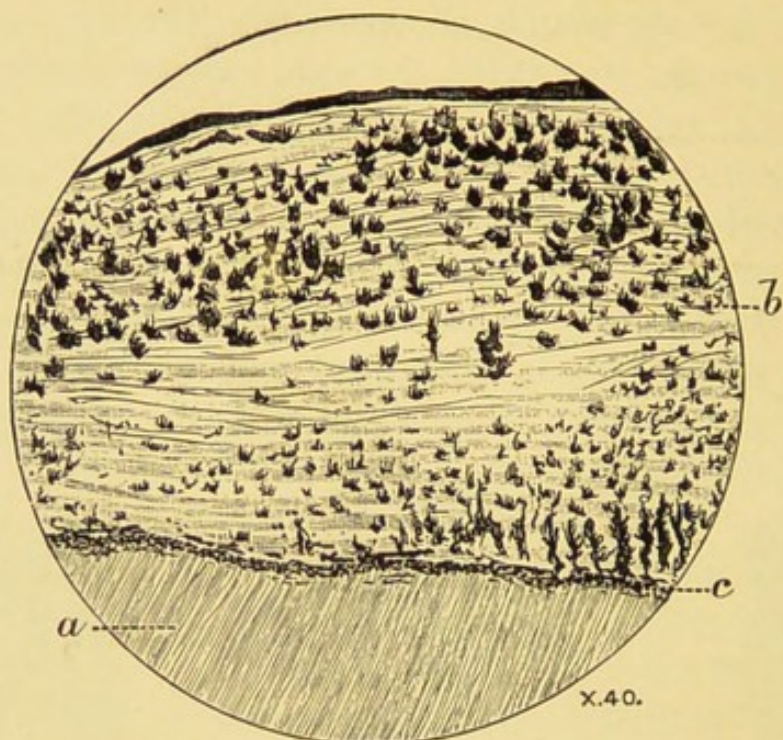


FIG. 273. Longitudinal section, showing exostosis. (a) Dentine; (b) exostosed portion; (c) granular layer.

laminated, the intercremental lines of Salter being generally well marked; these lines are situated at the junction of the laminae. The lacunae are very numerous, and slightly larger and coarser than under normal conditions, and are often fairly regularly placed (figs. 273 and 274), the canaliculi, as in the normal cementum, running towards the periphery of the tooth. When the deposit is of the irregular variety the new tissue will be found irregular, the laminae not being so well marked and the lacunae more irregularly placed (fig. 275). In this variety vascular canals are sometimes met with, and fresh formation again takes place, the junction of the two always showing the scooped-out appearance distinctive of absorption. This alternation of absorption and fresh deposition is well marked in cases where the microscopical appearances are

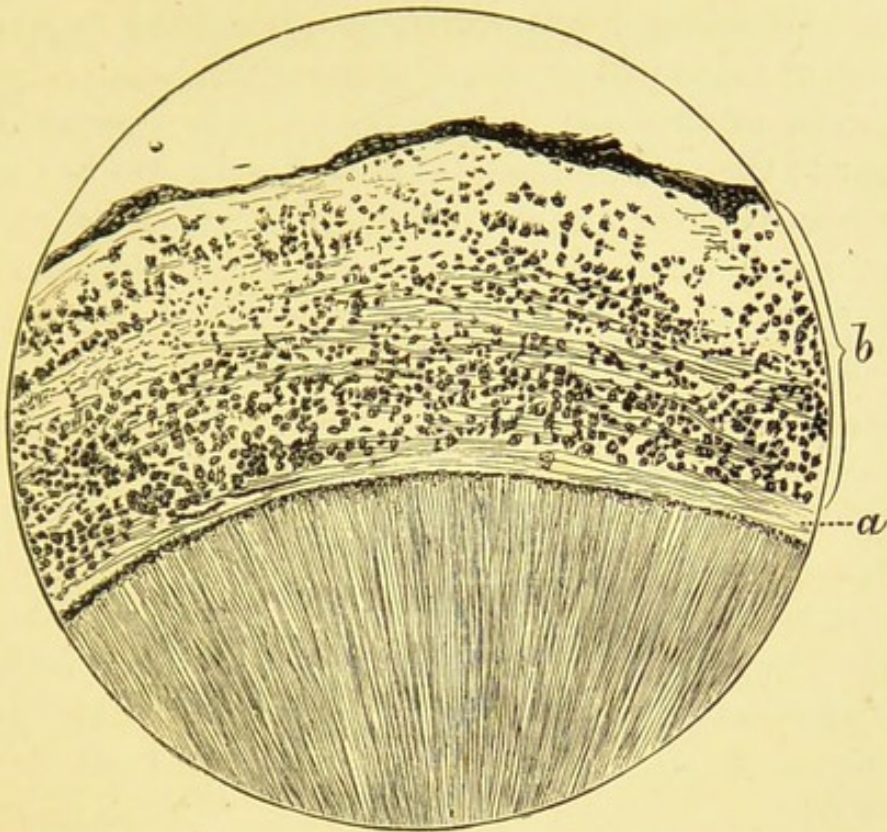


FIG. 274. (a) Original layer of cementum ; (b) tissue of new formation (exostosis).

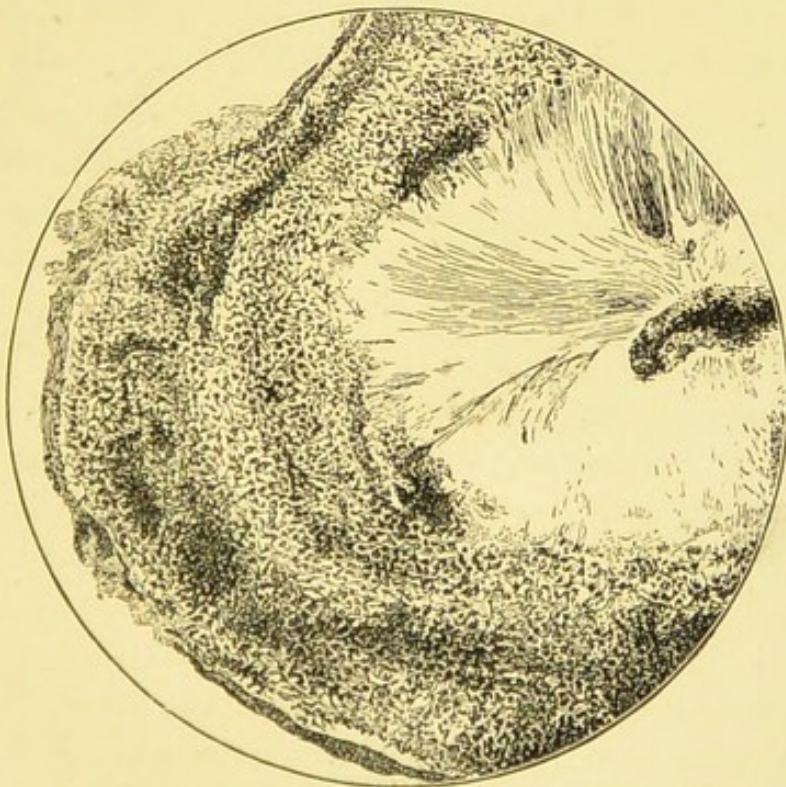


FIG. 275. From a specimen in the possession of Mr. Douglas Caush.

irregular. Occasionally the specimen will exhibit marked absorption at one side with exostosis at the other.

Mr. Caush, of Brighton, has devoted a large amount of time and labour to the preparation of exostosed teeth, and he notes the frequent occurrence of vascular canals running from the periphery towards the pulp canals, and believes that a very large number of these are produced by absorption taking place from the periphery of the tooth. Many specimens of exostosis show marked changes in the pulp chamber, consisting in the deposit of fresh tissue (secondary dentine), which is often of the osteodentine variety, and in some cases there are marked appearances of previous absorption of the dentine. This deposit inside the pulp cavity is no essential part of the pathological process outside the tooth, but is the result of chronic inflammation of the pulp itself; and as this is often associated with chronic periodontitis, the frequent appearance of the two deposits in the same tooth is easily explained.

The junction of the new with the normal tissue is often well marked; for example, in fig. 274 the granular layer is quite visible, and also the peripheral layer of cementum, which is so frequently apparently structureless. Such conditions point to the fact that the normal cementum was in no way interfered with by absorption, and that the process was very chronic throughout; but if the earliest inflammation of the periodontal membrane is fairly acute, the layer of normal cementum will be removed by absorption, together with at times a portion of the dentine. Under such conditions, when the inflammatory process becomes more chronic and undergoes organisation, the new tissue formed will be cementum, the granular layer disappearing, the boundary line of the dentine showing well-marked Howship's lacunæ. This absorption of tissue and fresh formation has been termed by Mr. Henry inostosis (fig. 276).

As already stated, dental exostosis is not a distinct disease, but is an inflammation of the dental periosteum, the products of which have become organised; the causes are similar to those leading to periodontitis, especially those giving rise to the chronic form, and,

as organisation of inflammatory exudation is frequent in people of gouty and rheumatic diathesis, it follows that exostosis often supervenes upon periodontitis.

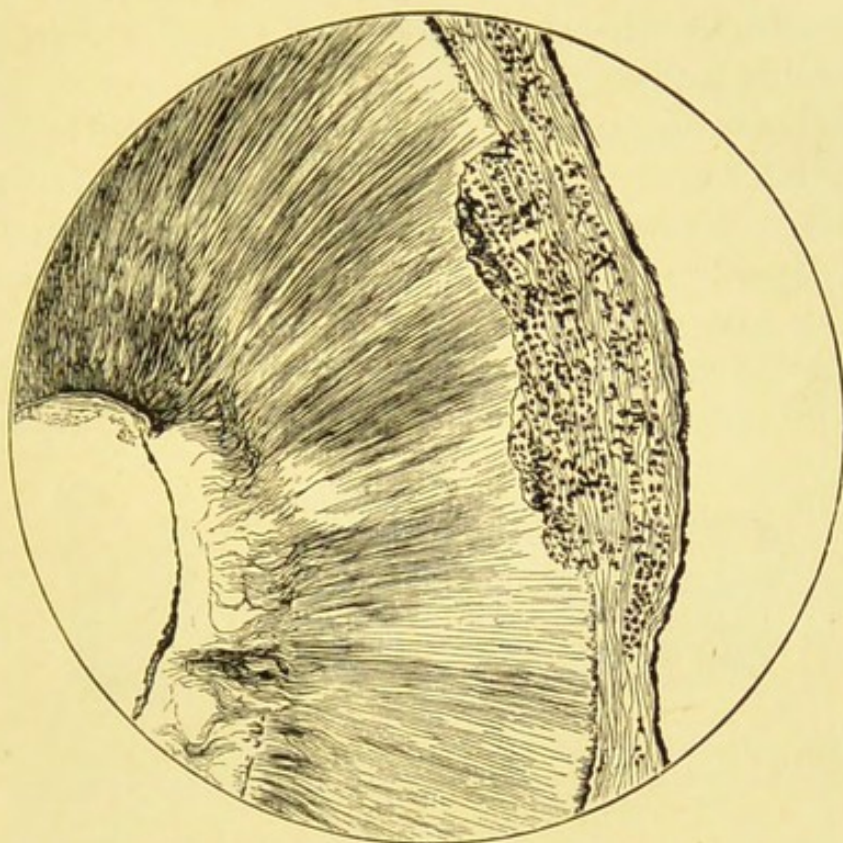


FIG. 276. From a specimen in the possession of Mr. Douglas Caush.

The *symptoms of exostosis* are similar to those of chronic periodontitis, the pain in many cases being very severe and of a neuralgic character. It is said that, by taking the tooth between the fingers and shaking it, pain is produced through pressure upon the nerves of the periosteum; a swelling on the outer or inner alveolar plate is sometimes present.

The *treatment of exostosis* which is causing painful symptoms may be palliative or radical. The palliative should consist in local counter irritation by repeated applications of some form of iodine, and the administration of potassium iodide, as this drug tends to produce absorption of inflammatory products. The radical treatment consists in extraction, an operation very often extremely difficult to perform.

Absorption.—In a previous chapter it has been seen that the absorption of the temporary teeth prior to the eruption of the permanent teeth is a physiological process. When, however, absorption occurs in the permanent teeth, or even the temporary under conditions other than those just stated, the process must be considered pathological.

The *naked eye appearances of the root* when attended by absorption depend upon the severity and position of the cause producing the absorption. When very chronic and occurring at the apex, the root will appear rounded at the end, and as the absorption continues the root will still retain the same appearance (figs. 277 and 278). If the cause acts at different places the absorption



FIG. 277. First lower molar showing absorption.



FIG. 278. First upper molar showing absorption of palatine root.

will be of an irregular character: this is frequently the case in replanted implanted teeth and roots carrying pivots (figs. 279, 280, and 281). When the cause acting is fairly acute, especially



FIG. 279.



FIG. 280.



FIG. 281.

if attacking one side with greater celerity than the other, a sharp edge is often left, giving rise to what is often called needle-point absorption (figs. 282 and 283). The absorption

of the root may be so extensive that only the crown is left. A good example of this is shown in fig. 284.



FIG. 282.



FIG. 283.



FIG. 284.

Microscopically, absorption shows the absorbed margin of the tooth to present the usual Howship's lacunæ (fig. 285), and if

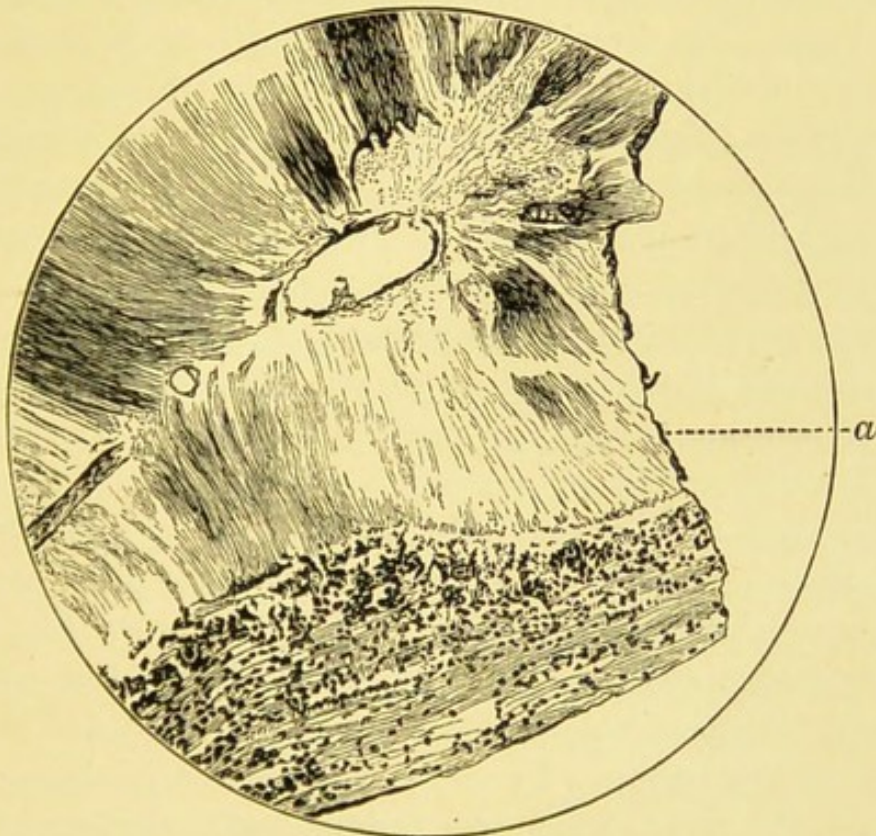


FIG. 285. (a) Absorbed margin of tooth, showing Howship's lacunæ. From a specimen in the possession of Mr. Douglas Caush.

the hard and soft tissue are cut *in situ* the lacunæ will be seen to be filled with osteoclastic cells. The immediate cause of absorption is chronic inflammation of the dental periosteum,

the inflammatory products, instead of organising as in exostosis, producing absorption; it is therefore somewhat analogous to rarefied osteitis.

In exostosis the inflammatory process is more chronic than in the case of absorption, and in the same teeth signs of both can often be met with. A common cause giving rise to the periodontitis which produces absorption is the passage of the end of a broken bristle or the projection of a root-filling through the apex. In many cases no cause is apparent, the tooth absorbing away and not giving rise to practically any trouble until absorption is far advanced.

Necrosis.—A tooth derives its nutritional supply from two sources, namely, the pulp and the periosteum. When the death of the pulp alone occurs a partial necrosis of the dentine takes place. This, from a clinical point of view, is unimportant, and does not, should the canal be properly treated, give rise to any symptoms; and it is quite probable that the dentine may still obtain nourishment from the periosteum by means of the cementum and granular layer. When, in addition to death of the pulp, the periodontal membrane becomes separated from the cementum, partial or complete necrosis of the tooth takes place. *Partial necrosis of the cementum* is common, and is generally the result of alveolar abscess, or may be due to absorption of the alveolus, as occurs in pyorrhœa alveolaris. When due to the former cause it will generally be at the apex of the tooth, and will act as an irritant and give rise to chronic trouble. A curious condition at times seen is in a single root of a molar tooth being laid bare (more commonly this is the palatine); but such conditions do not as a rule give rise to any trouble, and therefore call for no treatment. In cases of complete necrosis of the cementum the tooth becomes a foreign body, sets up irritation and ulceration, and it should be removed.

Alveolar abscess.—When inflammation of the dental periosteum terminates in suppuration an alveolar abscess is formed. Cases of alveolar abscess have been divided into two classes—(1) those commencing in the periodontal membrane, or between

that membrane and the root ; (2) those commencing externally to the membrane. For the first class Mr. Dolamore has suggested the term sub-periodontal, and for the second extra-periodontal.

The first class has been recognised by the majority of writers upon dental surgery. A plastic inflammation at first takes place around the apex of the fang or at any other part of the root, according to the seat of the abscess. The pressure of this exudation causes more or less absorption of the surrounding alveolar process ; suppuration commences in the portion of the periosteum adjacent to the tooth, and, as the pus increases in quantity, separates the periosteum from the cementum to a greater or less extent, being limited externally by the so-called sac. This sac will vary in thickness according to the severity of the inflammation. In acute abscesses it is seldom possible to demonstrate it ; in sub-acute cases it forms a thin, translucent wall, with a network of vessels traversing it ; while in the chronic cases it will be well marked, and found, according to Wedl, to consist of three layers—“(a) an external, thicker, more resistant layer, in which cells of an oblong shape, embedded in a fibrous stroma, predominate ; (b) a middle, less firm, more succulent layer, containing principally rounded, nucleated cells, which are inserted into a mass of filaments in parallel rows or in irregular clusters ; (c) an internal layer of a sort of granulation tissue, with the pus adherent to it.”

The position of the abscess in the periosteum is generally towards the apex ; it is, however, not necessarily confined to that point, but may be situated in nearly any part of the root.

The sac is generally pyriform in shape, embracing the apex ; at times it is somewhat elongated, attaining a length of nearly an inch. As the pus increases in amount, a corresponding absorption and bulging of the osseous walls takes place, especially of that one which is least resistant. A portion of this is eventually absorbed, the pus then finds its way through the perforation and points under the gum (gum-boil), which in its turn ulcerates and the pus escapes into the mouth. The period occupied by these phenomena in acute cases occupies but a few hours, and in

chronic cases an indefinite period of time. The reason the exit of pus takes place through the outer plate of the alveolus is that that plate is thinner, and therefore less resistant. At times the pus burrows in other directions, occasionally it makes its way up along the course of the root, escaping at the neck of the tooth. It may point in the hard palate; this generally occurs with the upper lateral incisor, the second bicuspid or first permanent molar, but it may arise from any tooth in the upper series. The abscess may point at the junction of the hard with the soft palate, or in the substance of this latter. From an upper tooth the pus may burrow into the nose, this is generally caused by a central incisor; or into the antrum, arising from the first and second molars or second bicuspid. The abscess may point in the face at any part from either an upper or a lower tooth. In one case occurring in the practice of Mr. Ewbank the abscess from an upper canine opened at the inner canthus of the eye. An abscess opening at the angle of the mouth was seen in a patient at the Dental Hospital of London, the diseased tooth being the first upper bicuspid. An opening under the chin or near the symphysis is generally due to one of the lower incisors. Fistulous openings at the angle of the jaw are generally associated with abscessed lower molars. The opening may take place in the floor of the mouth. In rare instances the pus has burrowed between the layers of the cervical fascia, and in one instance quoted by Mr. Salter in his *Dental Surgery* the abscess pointed above the clavicle.

Complications and sequelæ may arise, viz. :—(1) Inflammation, and at times suppuration, of the neighbouring lymphatic glands; (2) cellulitis of the muscles of the neck and œdema of the glottis (Heath, *Injuries and Diseases of the Jaws*, p. 103); (3) post-pharyngeal abscess, from burrowing of the pus between the deep processes of the deep cervical fascia; (4) pyæmia (a case of this is recorded by Howse in *Medical Times and Gazette*, 1876); (5) necrosis of the jaws; (6) closure of the jaws; (7) sinuses in the various parts where alveolar abscesses have broken. In one case which came under the care of Mr. Heath, the orifice was sur-

mounted by a horny-like growth, which consisted of epithelium on the top of the granulation around the fistulous opening.

The class which is termed extra-periodontal is generally more acute, and is due to the passage of instruments or septic matter through the apex into the surrounding tissue. It is quite possible that these cases may in some instances commence as sub-periodontal, but it is questionable whether this is the case.

The *symptoms of an alveolar abscess* do not differ from those due to an abscess in any other part of the body. Locally, they will simulate acute periodontitis. The tooth will be found loose; and in the stage during the formation of pus and the absorption of its bony casing, the swelling will not be very marked, but the pain will be intense, and of a dull, throbbing character. This symptom is always marked in strong people, whose bones are dense and resistant. After the pus has obtained an exit through the bony wall, the pain will be considerably mitigated, but the swelling will rapidly increase in size.

In acute cases general symptoms of fever are to be found, the pulse will be quickened, and the temperature slightly raised. There is generally a thickly-furred tongue, the urine may be scanty and high coloured, the skin hot and dry, and symptoms of general malaise will be present. In more chronic cases general symptoms will be practically absent, and in many cases of acute periodontitis will not be always well marked.

Although chronic abscesses do not give rise to any well marked general symptoms, patients with much suppuration in the mouth are frequently much debilitated, in fact seem to suffer from a very mild form of sapsræmia, which disappears upon the extraction of the teeth.

The diagnosis of alveolar abscess in its acute stage is not, as a rule, difficult. It must be differentiated from abscess arising in connection with necrosis, and also abscesses in connection with the lymphatic glands in the neighbourhood of the jaws. In chronic cases, the sinus opening externally may be mistaken for one arising from necrosis of the bone, or from a salivary fistula. In cases where the abscess spreads to the substance of

the bone, it may lead in the upper jaw to distension of the antrum, and in the lower jaw to bulging of the two plates of the alveolus. The differential diagnosis of these cases is referred to in the chapter dealing with the diagnosis of swellings about the jaws.

The *treatment* may be divided into the conservative and the radical, in the former an endeavour being made to save the tooth. Which method is to be adopted must naturally depend upon the character of each case and upon the judgment of the dental practitioner. The radical treatment is generally called for when the pus is welling up by the side of the tooth; when the symptoms are at all severe, or have a tendency to open upon the face. If extraction is decided upon, it should be at once performed, as nothing can be gained by waiting. The pus will generally find an exit by the socket of the tooth; but in all cases when the collection of pus is at all large or removed from the seat of trouble (such as palatal abscesses from upper lateral incisors), it is much better to freely open the abscess with a knife. The after-treatment consists in thoroughly syringing and rinsing the mouth with antiseptic solutions, and, if the abscess has been incised, taking care to keep the edges apart, and to allow of free drainage. It is always as well to prescribe a good saline purge, such as sulphate of magnesia; and in cases occurring in debilitated people, a tonic course of treatment is valuable.

If it is decided to attempt conservative treatment, then the abscess should be temporarily relieved by drilling into the pulp chamber (rhizodontrophy), and incising the abscess directly it points. When it is deep seated, the treatment must be directed to hastening the absorption of the bony walls, and this can be done by constant poulticing of the gum over the region of the tooth, and for this purpose hot figs, raisins, or capsicum plaster are useful. In some cases it may be even advisable to drill through the outer alveolar plate; and should this not quite open into the abscess, it will relieve the congestion of the parts and hasten the pointing. When the abscess threatens to burst externally, the tooth should immediately be removed, and

the abscess opened internally, and the skin supported externally by applying successive layers of cotton-wool covered with collodion over the affected region.

The pain of drilling into the tooth is severe, but much discomfort can be saved by holding the tooth steady during the operation and by using sharp drills. The opening of an alveolar abscess is not a dangerous operation; but, nevertheless, the dental surgeon should bear in mind that when occurring in the lower jaw there is a danger of wounding the facial artery, and this accident has occurred on more than one occasion. To avoid it, the cutting edge of the knife should be directed towards the bone, and the abscess opened as near the bone as possible. Should the artery be injured, it must immediately be compressed externally where it passes over the lower jaw at the anterior border of the masseter muscle, and surgical assistance sought. In the upper jaw, in opening abscesses in the palate, there is a risk of injuring either the anterior or posterior palatine arteries. The situation of these should therefore be kept well in mind when making the incision. When the painful symptoms have somewhat subsided, the tooth should be freely opened, and treated as described under the heading of treatment of pulpless teeth. After incising a swelling, pus is not always found, and it is not judicious to make further attempts, since the incision alone will relieve congestion, and at the same time the pointing of the abscess will be assisted.

Under certain conditions, alveolar abscesses become very chronic, the fluid contents being thin and clear, so that the conditions somewhat resemble a cyst, and some authors refer to abscesses becoming cystic; though it is difficult to see how this can happen. That an abscess may simulate a cyst in appearance is conceivable, but it is difficult to see how the sac of the abscess can be converted into a cyst wall, since for this latter the presence of epithelium is necessary.

True cysts connected with the roots of fully-developed teeth are occasionally seen, and occur in both upper and lower jaws.

They may be of small size, and give rise to no trouble, but at times they assume large proportions. The teeth they are connected with are always carious, and when extracted the cyst wall is adherent. Their origin is obscure. Malassez has described aberrant masses of epithelium in the dental periosteum, and it is quite possible that, under the effect of dental irritation, these may develop into cysts. Whether this is the right explanation is doubtful, nevertheless, it should be remembered that cysts are developed in connection with teeth, and that masses of epithelium are often to be found in the substance of the root membrane. In a case which recently came under the care of one of the authors, there was a large swelling in the upper molar region on the right side. The growth had gradually increased in size, and had been three years in existence. The second and third molars were carious, but quite free from inflammation; the growth was painless, presented no sign of inflammation, and, in addition, the veins running into the wall were easily apparent. The second and third molars were extracted, and adhering to the root of the latter, at a point distant about one quarter of an inch from the apex, was a portion of a distinct cyst wall. The remaining portion of this was carefully removed, and when examined was found to be fibrous in character, with a distinct smooth internal surface. The cavity left healed up by granulation. In one case, which was reported by Dr. A. W. Baker, the cyst was attached to the palatine root of a left upper molar, and, on section, was seen to be composed of three layers. The external "consisted of fibrous connective tissue with elongated cells, and was evidently derived from the root membrane, with which it was continuous. . . . Next came a middle layer with a few bundles of fibres, between which were irregular masses of round nucleated cells; while more internally was a layer of granulation tissue with some thin walled vessels. On the granulation tissue stood a double row of columnar ciliated epithelium."¹ When occurring in the lower

¹*Journal Brit. Dent. Assoc.* p. 61, vol. xii.

jaw these cysts will give rise to expansion of the bone, which may become so thin as to cause the sensation of crackling, and they may be mistaken for more serious trouble.

The *treatment* of these cysts to which the term "dental" is applied, in contra-distinction to "dentigerous cysts" or "follicular odontomes," is to extract any diseased tooth or teeth and remove as far as possible the cyst wall, packing the cavity with lint dipped in carbolic acid solution (1 in 20). This promotes the growth of granulations, and allows the cavity to heal by second intention.

Occasionally patients present themselves with small inflammatory swellings over the region of the teeth towards the neck, causing the teeth to be tender and uncomfortable. On examining the tooth it will be found apparently quite healthy and no possible cause for the swelling be discovered; the simple treatment of incision will effect a cure. These abscesses are rare, and interesting on account of their apparently obscure origin. In some instances the cause has seemed to be due to a foreign body, such as a piece of bone becoming wedged in the socket of the tooth near the neck. In this connection may also be mentioned the small abscesses which occur over the region of erupting wisdom teeth.

Abscesses, instead of forming in the alveolar portion of the upper jaw, may develop in the substance of the bone. In the upper jaw, they may invade the antrum, while in the lower they may lead to bulging of the two plates of bone. The causes of abscess forming in the substance of the bone may be (1) extension of suppuration from the alveolar portion; (2) suppuration of a dentigerous cyst; (3) repeated blows upon the bones; and (4) necrosis of the jaws. They will have to be carefully diagnosed from other swellings.

The *treatment* consists in free incision into the abscess to evacuate the pus. Any cause, such as dead bone or a diseased tooth, should be removed, and the case subsequently treated by antiseptic injections.

Pyorrhœa alveolaris may be described as a progressive de-

struction of the periosteum accompanied by absorption of the alveoli. In old age absorption of the alveolus is a natural process, but when this condition takes place in younger people it is distinctly pathological. In the early stages the margins of the gum will be seen to be slightly thickened, congested, and painful, the tooth being probably slightly loosened. If pressure be made upon the gums a small amount of pus may be seen escaping by the side of the tooth. This is, however, not always present, especially if the disease is chronic. A probe passed between the gum and the tooth will demonstrate that the membrane is separated from the tooth, so making a much larger pocket than normally exists. This separation of the tooth from its attachment increases, the tooth gradually becoming looser and eventually lost. The destruction of the membrane may take place symmetrically around the tooth, or may start at one point, proceeding in a downwards direction, so that the tooth on one side may be completely bared from its neck to its apex, but still retaining a connection by its opposite side. In many cases it is stated that as the destruction advances in a longitudinal direction it also widens, so that one side of the tooth and the whole of the apex may be completely bared of periosteum (fig. 286) and yet be retained by membrane at the other

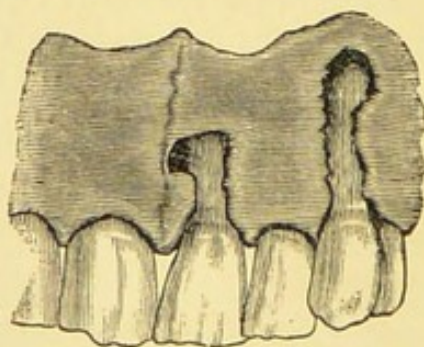


FIG. 286. From *The American System of Dental Surgery*.

side of the tooth. As the periodontal membrane is destroyed so the alveolar process supporting the tooth also disappears. This absorption or destruction of the sockets of the tooth is well seen in dried specimens. The destruction is much more marked

towards the upper than the lower part of the tooth, giving the socket a trumpet shape; but where the affection is limited to one side of the root, then only that portion of the alveolar wall will be affected. Some authors, and amongst them Dr. Black, have described in chronic cases a slight thickening of the margins of the socket. This is seen in fig. 287. In addition to the

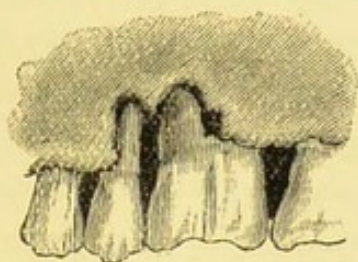


FIG. 287. From *The American System of Dental Surgery*.

destruction of the alveolus and periodontal membrane a thin ring or nodule of hard, dark-coloured tartar will be found encircling the tooth and lying under cover of the gum. This is generally present, though not always, and must probably be regarded as a result of the disease rather than a cause. The disease may be acute or chronic, may be limited to one or two teeth, or may be general. At times it shows a tendency to spread from tooth to tooth, as if the affection were due to some infective micro-organism. This condition was well marked in one case under observation, in which at first the right upper central incisor was attacked and the approximal surfaces of the adjacent central and lateral, the opposite sides of these teeth being free. The disease, however, gradually spread to these surfaces, and so to the next adjacent teeth.

The aetiology of pyorrhœa alveolaris is a much vexed question. It seems predisposed to by gout, rheumatism, struma, rachitis, and anhygiene conditions, in diseases where there is peripheral congestion, such as is caused by certain forms of valvular disease of the heart. Severe fevers, as typhoid, may also act as predisposing causes, *e.g.* in two patients seen who had recovered from typhoid fever there were distinct signs of the disease attacking all the teeth. Both these patients, previous to their

illness, had never suffered from the slightest symptom of pyorrhœa alveolaris. This is interesting when it is remembered that fever leads to a degeneration of fibrous tissue, which is the principal factor in the composition of the dental membrane, so that it is more than possible that conditions lowering the vitality of the membrane predispose it to attack. In tabes dorsalis and diabetes the teeth are often lost prematurely by absorption of their alveoli. Teeth in which there has been periodontal trouble, teeth which have been regulated, more especially projecting front teeth which have been drawn inwards, seem predisposed to pyorrhœa alveolaris. The presence of some irritant, such as tartar, may in some

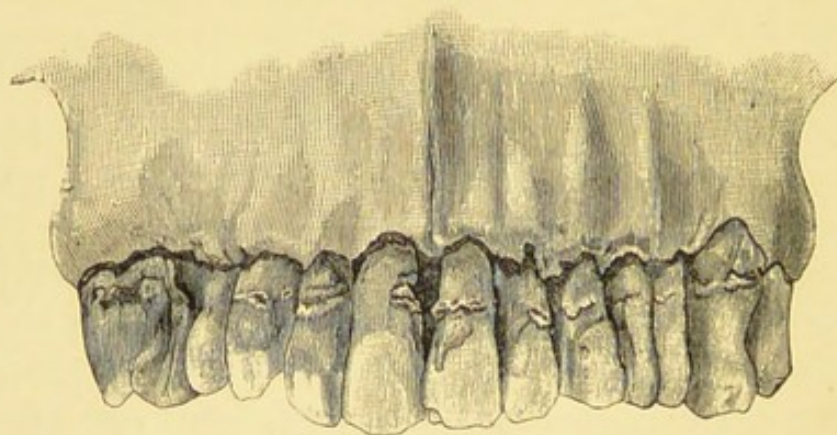


FIG. 288. Showing the teeth and alveolar process of a patient who suffered from pyorrhœa alveolaris. The rim of tartar, the thickened margin of the alveolar process, and the hollowing out of the orifice of the socket being well marked. From the Museum of the Odontological Society.

cases act as the predisposing cause, but the hard rim of tartar so frequently seen in these cases is probably derived from the secretion from the periosteum, and is therefore a result and not a cause of the disease.

Many consider that the disease is a caries in bone, and they would therefore assign it to the category of bone diseases, but against this can be urged the fact that removal of the tooth or teeth always effects a complete cure. That tartar is not the only cause is shown by the absence of it in many cases and by the fact that when present, and the mouth is kept clean, it is

separated by some little distance from the bone, and if removed the disease may still continue. Some consider that pyorrhœa alveolaris is a general disorder. Amongst these are Messrs. Newland-Pedley and Bland Sutton, the latter observer stating that "the disease is undoubtedly of constitutional origin, but also requires local treatment."¹ Others consider the disease of a parasitic nature; amongst these is Galippe. Miller, who has undertaken investigations with the object of determining the presence of a specific micro-organism, did not find one of constant occurrence, but was able to cultivate "a large number of bacteria in pyorrhœa alveolaris which possessed pyogenic properties."

Taking all points into consideration, pyorrhœa alveolaris seems (1) to be present in many persons suffering from general disorders or diathesis; (2) to be excited in many instances by local irritants, such as the presence of tartar, débris of food, mechanical injury from abnormal articulation, such as occurs in many outstanding upper front teeth.

Treatment.—The first step in the treatment of pyorrhœa alveolaris will be to remove any teeth which may be hopelessly loose. Following this the teeth should be thoroughly scaled and cleaned, every portion of tartar being removed. The pockets formed round the teeth should then be syringed out by means of a hypodermic syringe, with a solution of perchloride of mercury 1 in 500. Instead of the perchloride, peroxide of hydrogen or ozonic ether, or any other equally effective germicide may be used. The pockets of gum should then be packed with some pure sulphate of copper, this step being easily carried out with the aid of a thin wedge-shaped piece of wood. Instead of sulphate of copper many use aromatic sulphuric acid, but the former seems to give the better results. The patient must be advised to use a soft tooth-brush, and twice a day to swab the gums with a saturated solution of tannin in eau-de-Cologne. The application of copper sulphate should be repeated every two or three days, and at each visit any fresh pieces of tartar which can be seen should be removed. In many cases marked improvement will be apparent in two or three

¹ *Dental Record*, May, 1887.

weeks, but in others treatment seems of little avail. Cases which seem apparently cured often show signs of recurrence. A patient should therefore be advised of the necessity of making a visit to the dental surgeon at least three times a year. In cases where the disease is progressing rapidly some operators use stronger drugs than sulphate of copper, and Dr. Riggs, who was the first to notice the disease, used to remove the margin of the alveolus. The prognosis of pyorrhœa alveolaris is bad, especially when occurring in teeth situated at the back of the mouth. In anterior teeth its ravages may be retarded for a time, and in some few cases a cure may be effected.

CHAPTER X.

EROSION—ATTRITION—ABRASION.

EROSION may be described as a gradual disappearance of a portion of the substance of a tooth, leaving behind a polished surface, the cause being obscure. The appearance produced by erosion varies considerably. It more frequently attacks the anterior teeth, and it nearly always occurs upon the labial surface, though in rare instances it may occur upon the lingual. A case of this latter variety was recorded by Mr. Ackery in *The Transactions of the Odontological Society* for November, 1890, and the teeth are shown in fig. 289. This patient had never worn a plate or used a tooth-pick.

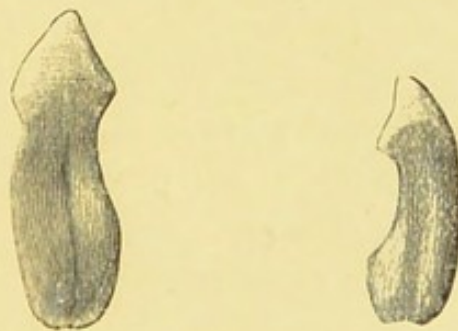


FIG. 289.

It is said to be commonest upon the upper canines and lower bicuspid; but this, as will be referred to subsequently, is probably due to abrasion. True erosion is probably commoner upon the central and lateral incisors. In some cases it is found that most frequently the erosion produces a V-shaped-like cut,

the apex of the **V** being towards the axis of the tooth. In these instances the situation is near the level of the gum. In others it appears as a cup-shaped depression upon the labial surface (fig. 290), or it may produce grooving upon the approximal surface.

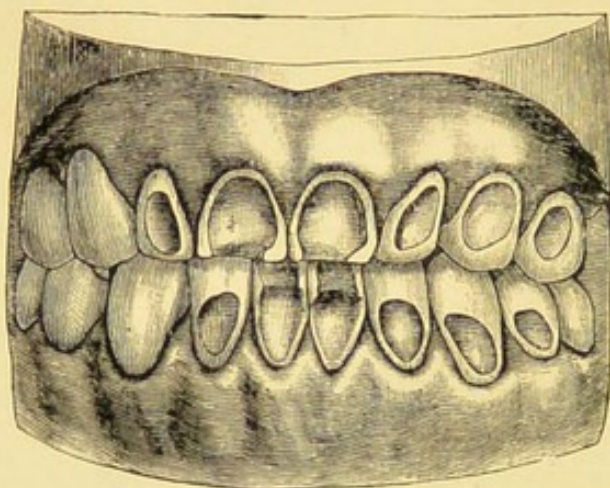


FIG. 290. From *The American System of Dental Surgery.*

Another way it may show itself is by producing an appearance similar to figs. 291 and 292. The teeth look as if they have been pared down with a knife in a direction sloping from the labial to the lingual surfaces, and when the mouth is closed a considerable

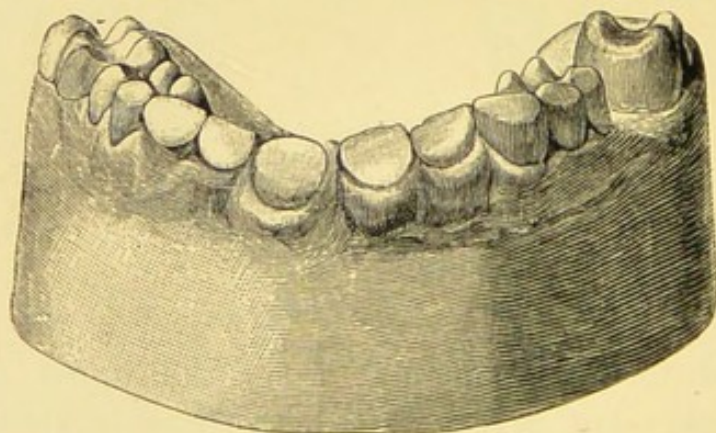


FIG. 291.

interval is left between the upper and lower teeth (fig. 293).

Erosion is generally more marked upon one tooth, and, according to some authors, extends from tooth to tooth, and generally more rapidly on one side than the other. The eroded

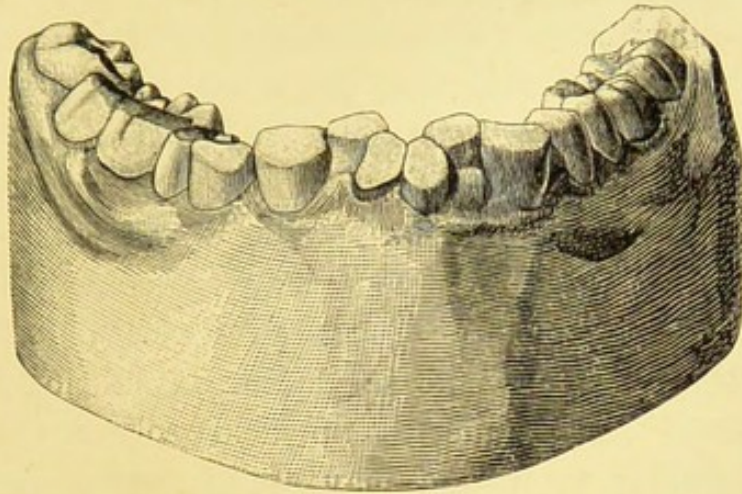


FIG. 292.

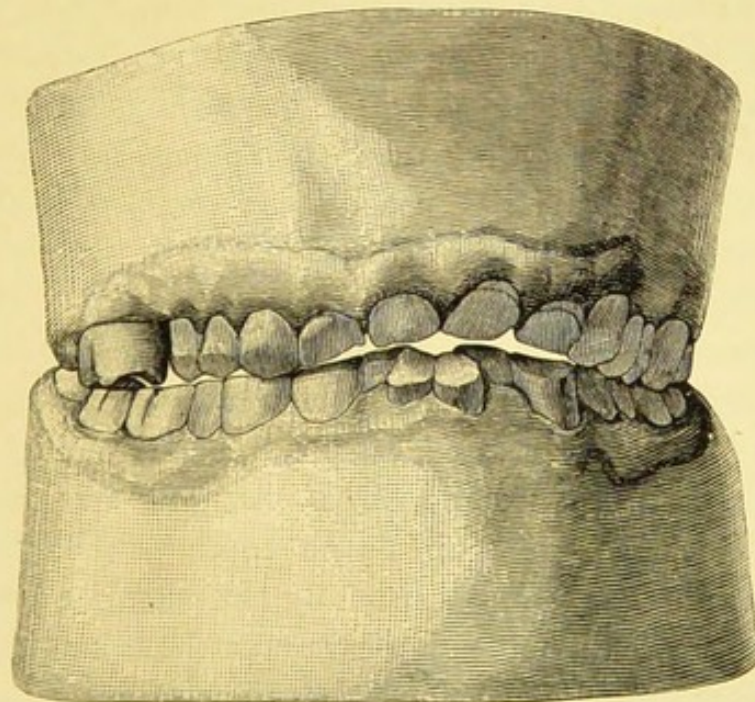


FIG. 293.

surface is hard, polished, and often very sensitive. Erosion nearly always commences in the enamel, but it may begin in the cementum; and in a case which came under the notice

of one of the authors, the central and lateral incisors were grooved on the labial and approximal surfaces, allowing the enamel to stand out quite prominently.

Microscopically, the appearances of eroded teeth are not of any definite character. In the enamel at the seat of erosion Mr. Underwood has found that the tissue is structurally defective, being granular; and is more easily acted upon by acids than well-made tissue. Sections of the dentine simply show the fibrils or tubes ending abruptly, as if cut with some sharp instrument. A point of some interest is the fact that, stained as carefully as possible, the tooth substance adjacent to the eroded surface does not take the stain, a condition that might be expected if really due to an acid solvent action. An appearance similar to erosion may appear upon teeth used as artificial substitutes upon plates; such cases are recorded by Dr. Parmly and Mr. Harrison.¹ The pulp chamber will also be found to contain secondary dentine, the tissue being situated at the pulp end of the irritated dentinal fibrils.

The cause of erosion is obscure, for nothing quite definite or satisfactory has yet been advanced to account for all the appearances produced. From a general point of view, it seems to be connected with gout, for a large majority of patients suffering from erosion are distinctly of gouty diathesis. It advances with varying rapidity, in some instances being rapid, in others chronic; and it may in one individual be acute, and then apparently become arrested. The mucous follicles of the adjacent lip appear in some cases distinctly red, especially at the part which comes against the tooth. Still further, the reaction of the saliva, and especially the buccal mucus, in such mouths is often acid; but much care must be taken in testing for this, as it is extremely easy for errors to arise.

Dr. Black² has produced, by the prolonged action of dilute acids upon teeth, a condition in some respects resembling erosion. In one experiment he records, two fresh, healthy bicuspid were

¹ *Odonto. Transactions*, May, 1870.

² *American System of Dental Surgery*, vol. i. p. 1004.

placed with their proximal surfaces together, gutta percha being enveloped round the roots so as to have only the crowns exposed; these were then placed in a jar containing dilute hydrochloric acid (1 in 400), and by means of an ingenious apparatus a current was obtained, the teeth being arranged in such a way that the current, in impinging upon their outer surfaces, struck one with greater force than the other, the result being the disappearance of the cusps and the formation of a groove between the teeth; this groove was more marked upon the one which received the greater force of the current. A large number of other observations were carried out, and it was found that strong solutions produced general softening, while a solution of 1 of acid in 5000 of water had not an appreciable effect after three months' trial.

Erosion is met with in the teeth of the lower animals, and seems to be more frequent in seals. Mr. Sutton (*Trans. Odontological Society*, 1884-5) has shown that some of these cases of erosion are associated with constitutional bone mischief, and, in summing up the subject, remarks that "there are two things to bear in mind, the association of erosion with the constitutional bone disease, and with functionless and therefore imperfectly developed teeth. Serious disease during dentition often leads to ill-formed teeth; hence one circumstance asserts itself most in connection with erosion of the teeth in animals, viz., defective development. Whether constitutional disease and imperfect development can be regarded as causes of erosion occurring in human subjects I must leave to those more intimately acquainted with their teeth than myself, but it seems a very probable explanation." Electrolysis is supposed by some to play an active part, while others are of the opinion that certain clinical facts point to a kind of absorption.

Mr. Hutchinson has described on the surfaces of eroded teeth a darkish film; this is certainly present in some cases, but it is often absent. No satisfactory explanation of this film has yet been given. The diagnosis of erosion has to be made from abrasion, attrition, and caries.

The *treatment of erosion* is unsatisfactory. In the early stages the use of an alkaline mouth-wash should be advised, as also the local application of spirits of ammonia and spirits of wine. A soft tooth-brush should be used and tooth powder discontinued, an antiseptic solution being used instead. The reason for discontinuing the tooth powder is that, being composed of powder, it might assist in the progress of the disease. If the eroded spots are painful, they may be touched with phosphoric acid, chloride of zinc, or, if in a place which does not show, nitrate of silver may be used; or a paint may be prescribed, the patient being instructed to dry the tooth and paint on the solution, keeping the tooth dry to allow the material to harden. The following will be found useful:—

R.	Gum-mastich (powder),	-	-	-	-	ʒj.
	Chloroformi,	-	-	-	-	ʒss.
	Zinci chloridi,	-	-	-	-	ʒv.
Misce.	To be used as a paint.					

When the erosion is more advanced, the cavity should be shaped and a filling inserted, preference, in the front of the mouth, being given to gold.

Attrition.—Attrition is a wearing away of the tooth substance, caused by mastication. It is seen more frequently in the teeth of the old, and in the temporary teeth of the young. The amount of attrition depends to a great extent upon the character of the food, the density of the tooth substance, and the articulation. It may attack the surfaces of all the teeth, or affect only one or two teeth. When localised, it is generally due to some irregularity of the bite. The case shown in fig. 294 is a good example of this. In the lower jaw, the two central incisors are nearly level with the gums; this is due to the crowding of the upper teeth, allowing the mesial surfaces of the teeth to be turned inwards, and so causing them to impinge upon the lower centrals. Attrition is always more marked in people of gouty diathesis. Examined microscopically, the dentinal tubes are seen to end abruptly upon the worn surface, while the pulp chamber

shows deposits of secondary dentine, and the pulp atrophic changes.

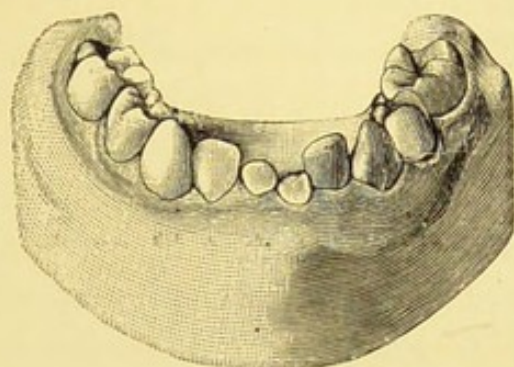


FIG. 294.



FIG. 295. Lower first molar, showing attrition.



FIG. 296. Lower first molar, showing attrition, which is more marked on the posterior aspect than the anterior.



FIG. 297. Upper central incisor, showing well marked attrition on palatal aspect.

Treatment.—In the majority of cases treatment is not necessary. In those where the posterior teeth are absent and the anterior ones are being worn away through bearing the brunt of mastication, dentures should be inserted, and arranged in such a way that the bite is taken off the front teeth. In some cases the patient will refuse to submit to dentures; under such circumstances, the progress of the destruction can be arrested by filling the cavity with gold, bringing the filling over the edges of the enamel, in such a way that in occlusion the gold fillings become in contact, and consequently the progress of tooth destruction is arrested. This treatment is most effectual, but the appearance produced is somewhat unsightly.

Abrasion.—By abrasion is understood destruction of the tooth substance through friction from a foreign body, such as a denture, pipe, or tooth-brush. (Some authors would include attrition and abrasion together.) Abrasion is more likely to be mistaken for erosion than for attrition. It may occur on nearly any tooth, and is very frequently caused by the presence of a clasp. It is probably the cause of some of the V-shaped cavities seen upon the anterior teeth near the gum margin, and although some of these may be due to erosion the majority are the result of abrasion. These cavities are common upon the upper and lower canines and the lower first bicuspid. This may be



FIG. 298. Upper canine, showing abrasion from a wire attached to an upper denture.



FIG. 299. Upper central, showing abrasion from a wire attached to an upper denture.

accounted for by the fact that these teeth are the prominent parts of the curves of the arch, and therefore more likely to be

affected. Again, this condition is at times more marked upon the left than the right side, probably from the tooth-brush being used transversely, and from the fact that in a right-handed person more force would be applied in cleaning the left rather than the right side. That this seems to be the explanation is shown by the fact that in a patient (left-handed) who came under the notice of one of the authors, the destruction of the tooth was more marked upon the right side than the left. In support of the fact that the tooth-brush used transversely is probably the cause of this form of destruction, may be mentioned another case in which, by accident, the left upper central incisor had been completely dislocated and subsequently replaced by the patient, but unfortunately had slightly elongated and become fixed in a position anterior to the approximal teeth. This tooth, with the right upper central and both lateral incisors, was attacked by the V-shaped destruction, the point of interest being that the prominent incisor was much more damaged than the adjacent teeth; and when a suitable instrument was placed along the apices of the V it was found to be on the same level. Many cases cannot be satisfactorily explained on this hypothesis. The treatment of abrasion is similar to that of erosion.

CHAPTER XI.

DISEASES OF THE GUMS AND ADJACENT MUCOUS MEMBRANE.

IN considering diseases of the gums it may be pointed out that many are not essentially limited to the area of the gums, but involve at the same time the cheeks and other parts; but in other cases, the gums may only be secondarily affected, the disease having a deeper origin, as in the case of necrosis of the jaws.

Hypertrophy of the gums.—Cases of hypertrophy of the gums have been from time to time recorded; they are, however, few in number, and the affection must be regarded as very uncommon. The gums become considerably increased in size, are generally nodulated, of a darker colour than normal, and bleed freely on the slightest touch. In children the hypertrophy appears coincident with the cutting of the teeth; in the case quoted by Mr. Erichsen, the affection showed itself at seven months, during the eruption of the incisors; and in another case, quoted by Mr. Christopher Heath,¹ the swelling of the gums commenced at two years of age, as the temporary molars were erupting. If left alone the hypertrophy of the gums increases so that the teeth may become completely hidden: such a condition will give rise to great difficulty in mastication. In Mr. Erichsen's case, to which reference has already been made, the patient subsequently developed abnormalities of the skin, periosteum, and

¹ *Injuries and Diseases of the Jaw*, Christopher Heath, p. 230.

extremities of the fingers and toes. Fig. 300 is taken from Mr. Christopher Heath's work on *Injuries and Diseases of the*

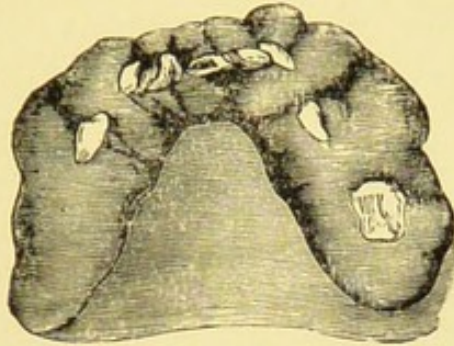


FIG. 300.

Jaw, and give some idea of the condition presented in this disease; and figs. 301-304 delineate the mouths of two brothers, aged respectively seven and nine years. They attended as patients at the Dental Hospital of London about the end of 1892 for a well marked condition of hypertrophy of their gums.

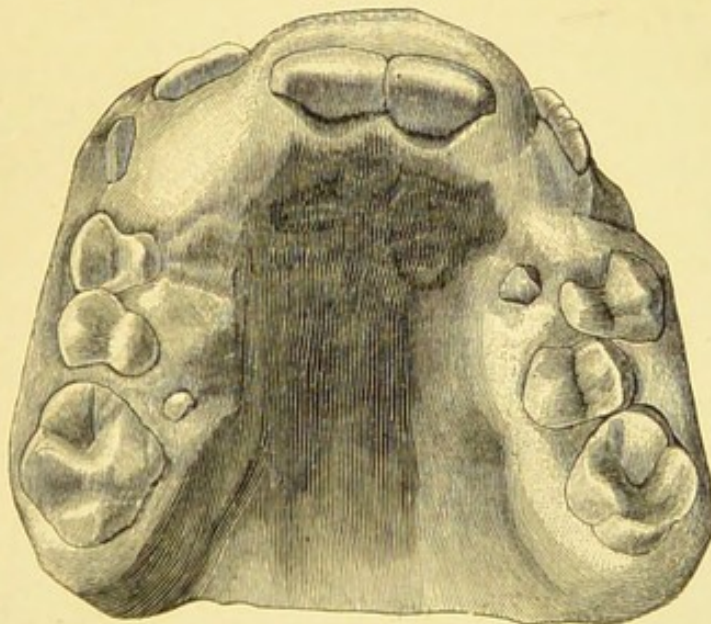


FIG. 301. F. S., æt. 9. (Upper.)

A microscopical examination, made by Mr. C. S. Tomes, of Mr. Heath's case showed that "the growth closely resembled that of the small polypi which are sometimes found occupy-

ing the cavity of carious teeth ; it was a true hypertrophy of the gum, and chiefly of the fibrous portion. It sprang from the periosteum round the neck of the tooth, just within the margin of the alveoli. From this point a dense stroma of interlacing fibres, covered by a thin mucous and epithelial layer,

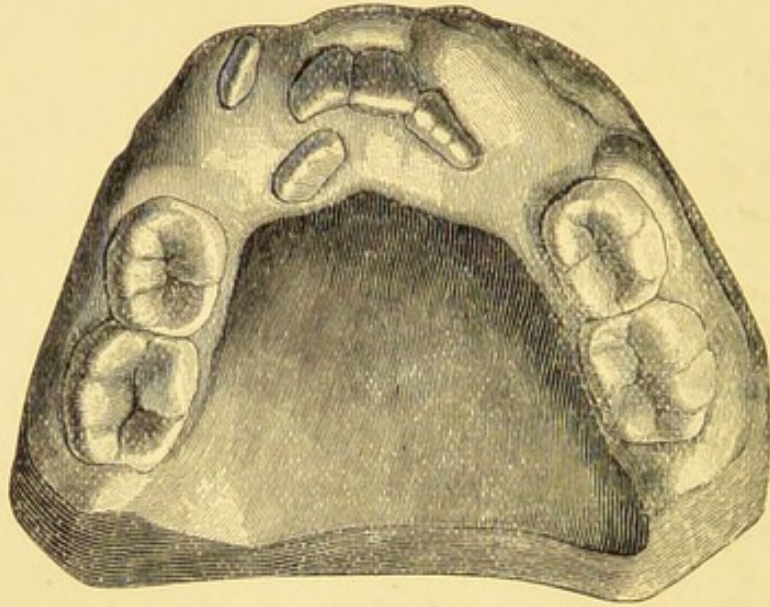


FIG. 302. F. S., æt. 9. (Lower.)

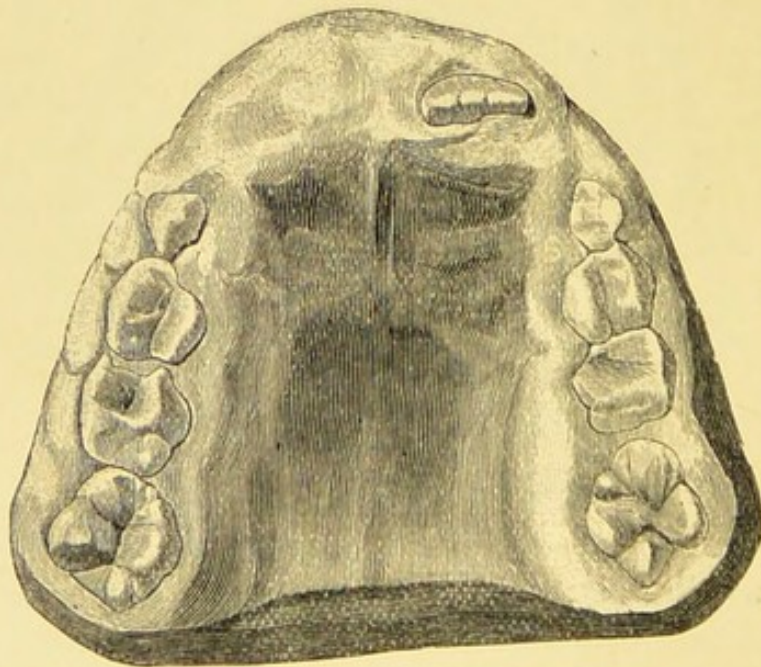


FIG. 303. T. S., æt. 7. (Upper.)

grew up round the tooth, the growths from opposite sides meeting over it and coalescing, so as almost to cover it."

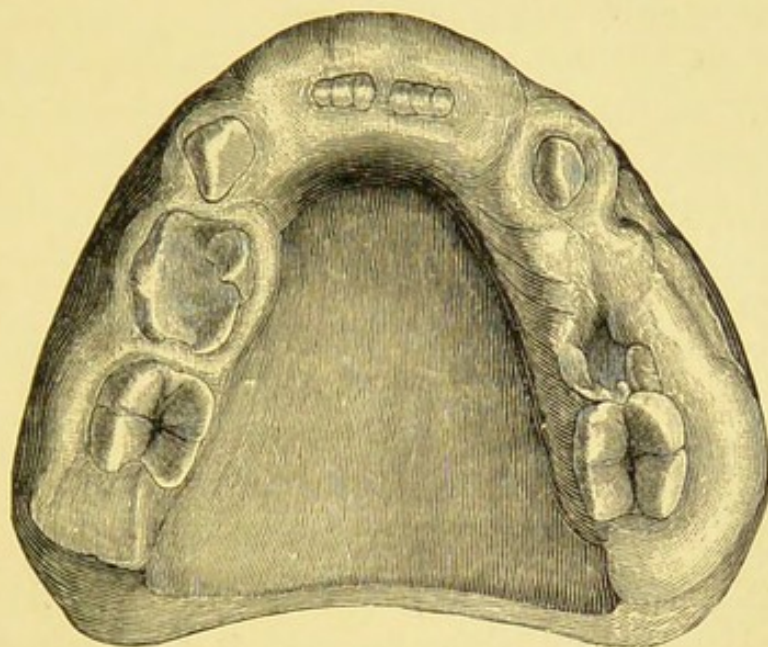


FIG. 304. T. S., æt. 7. (Lower.)

Hypertrophy of the gums may arise from badly fitting dentures, or from continued irritation from tartar; but in these cases the hypertrophy of the gums is never so great as in the congenital condition. *The treatment of hypertrophy of the gums* consists in not only removing the excess of gum, but also the affected alveolus. Cases treated in this way generally do well, but if paring of the gum is simply resorted to, recurrence of the trouble is likely to take place. This took place in the case treated by Erichsen, while in those recorded by Heath, MacGillivray, and others, the treatment was successful, and in these cases the affected alveolus was also removed. It has been noted that in microscopical section the growth apparently grew from the socket, which probably explains the successful result of cases treated by excision of the alveolus.

When due to irritation from plates, the cause should be removed, and this, with the application of an astringent solution, will generally prove sufficient; but in one such case Mr. Heath

found it necessary to remove some of the hypertrophied tissue with the thermo-cautery.

Acute inflammation.—Acute inflammation of the gums may be (a) simple or catarrhal, (b) mercurial.

(a) *Simple or catarrhal.*—This form is generally associated with inflammation of the throat or nose, and probably arises from the same cause which excites catarrh of those parts. The margins of the gums become acutely inflamed and painful to the slightest touch. There is a certain amount of swelling. In the early stages the gums are dry, but this is soon followed by an excessive secretion. The portion of gum attached to the margin of the alveolus is pale, while the reflection of gum from this point on to the cheek will show the vessels congested. The gums appear whitish and mottled, and pus is generally seen welling up from the sulcus around the teeth.

The mottled appearance of the gum is due to the fact that in inflammation the epithelium proliferates, and appears whitish ; but through the friction which occurs between the gums and the cheeks, the epithelium covering the papillæ of the gum is rubbed off, and leaves reddish patches here and there. The breath is fetid, the patient has a sensation of heat, pain, and, at the same time, an impairment of taste. The tongue is furred, there is loss of appetite, derangement of the bowels, and a feeling of malaise.

The treatment.—A purge should be administered, and some form of tonic prescribed, *i.e.* iron, quinine.¹ Mouth-washes containing antiseptics and astringents should be used.

(b) *Mercurial.*—Prolonged use of mercury is likely to lead to acute inflammation of the gums, which rapidly spreads to contiguous parts, such as the salivary glands, in which case it causes ptyalism. The earliest symptoms are soreness and discomfort in

¹ Liq. strychninæ,	-	-	-	℥v.
Liq. ferr. perchlor.,	-	-	-	℥x.
Aq. chloroformi,	-	-	-	ʒij.
Inf. quassiaæ ad	-	-	-	ʒj.

M. Mitte ʒviiij. Two tablespoonfuls three times a day.

the mouth, accompanied by a metallic taste, and the breath is fetid. The gums become inflamed, and present a deeply congested appearance at the free edge, while the portion attached to the margin of the alveolus remains whitish, and the portion beneath presents the whitish mottled appearance referred to above. The teeth become loose, sloughing and ulceration occur near the margin of the gum, the sloughs separate, and the teeth fall out. The inflammation spreads rapidly to the cheeks, tongue, floor of the mouth, and to the salivary glands, leading to a profuse flow of saliva. There is much pain both in swallowing, speaking, and endeavouring to move the jaws. In severe cases, if not quickly treated, extensive sloughing and necrosis may supervene.

The treatment consists in the use of mouth-washes, *i.e.* Condly's fluid, or a solution of carbolic acid [1-40]; local depletion by scarifying the gums will also be found advantageous. General treatment will consist in stopping the use of the mercury, and in administering brisk purgatives.

Chronic inflammation.—This condition may be general, or limited to the margin of the gums. In the latter case the trouble is generally caused by the presence of tartar or the accumulation of débris of food. The free margin of the gum is red, swollen, congested, painful, and bleeds freely at the slightest touch. In patients of strumous diathesis, the inflammation leads to hypertrophy of the margins of the gums, so that large tags of tissue are found between the interspaces of the teeth, the gum encroaching much upon the surface of the teeth so as to cause a large portion of them to be hidden. This form of inflammation would be well designated "chronic hypertrophic inflammation."

Small localised patches of inflammation are occasionally seen, for which no cause can apparently be found. A general chronic inflammation is often seen in patients wearing artificial dentures, and is said to be due more to the use of the red rather than the other forms of vulcanite; but this is questionable, as it occurs in the mouths of patients wearing metal plates. The gums in these

cases are slightly swollen, are red, congested, and painful, and the use of the plate is rendered unbearable.

Mr. Tomes¹ also describes a chronic inflammation of the gums, atrophic in character. The gums "assume a very red, smooth, and polished surface, and mottled aspect. At the same time the disease may extend over the surface of the hard palate. The malady is attended with acute intermittent pain, which may be confined to one side of the mouth, or even to half of the upper jaw; it very commonly comes on in the evening, and keeps the patient awake half the night." The trouble seems to occur in females about the period of "menopause."

The treatment of chronic inflammation of the gums will depend upon the cause. In the first place, any source of irritation present must be removed. If tartar is the cause, the teeth must be thoroughly scaled, an operation which will probably require two or more sittings, owing to the readiness with which the gums bleed. Applications of astringents to the gum should be made, such as powdered tannin, and an astringent tooth-powder or mouth-wash should also be used. Painting the gums with equal parts of tincture of iodine and spirits of camphor will be found especially useful in cases where there is pain.

When the inflammation is of the hypertrophic variety, it is useful, in addition to the above treatment, to cut off with a small pair of curved scissors the little tags of gum which occur in the interstices of the teeth, and freely scarify the other portion of the gum. In the variety occurring under dentures, the trouble can generally be cured by temporarily relinquishing the use of the denture and by using astringent mouth-washes. A slight aperient is useful.

In the form of "atrophic" inflammation, which is described by Mr. C. S. Tomes, an aperient, such as sulphate and carbonate of magnesia, or cascara-sagrada and rhubarb, given in small doses daily, will generally effect a cure in a few days.

Scurvy.—The effect of scurvy on the gums is that they become dark, turgid, spongy, and swollen, so as to hide a considerable

¹ *Dental Surgery*, 3rd edition, p. 726.

portion of the surfaces of the teeth. At first the gums bleed readily; this is followed later on by a constant oozing. Ulceration and sloughing of the edges of the gum take place, leading to loosening and loss of the teeth and necrosis of portions of the jaws. In scurvy the mucous membranes are anæmic; and there will be a strong contrast between the reddened gum and the pale mucous membrane covering the lips. The local symptoms are always associated with marked general symptoms indicative of the disease.

The treatment of scurvy cannot be dealt with here. Suffice it to say that the mouth must be kept quite clean and aseptic by the constant use of antiseptic lotions.

Purpura.—Purpura is a disease characterised by escape of blood in various parts, and indicated by petechiæ and ecchymoses under the skin. In the mouth it shows itself by hæmorrhages from the gums and mucous membrane. A very similar condition to this is occasionally seen in people, the subjects of hæmophilia, spontaneous hæmorrhage occurring from the margin of the gums.

The treatment of purpura, like scurvy, is general, and belongs to medicine. The hæmorrhage from the gums can be treated by the use of some astringents, such as tannin, the application being combined with a certain amount of pressure.

Thrush.—Thrush is a parasitic inflammation of the mucous membrane of the mouth. It is common in infants, but may occur in adults, and in the latter is generally associated with either some of the acute specific fevers or chronic wasting diseases, such as phthisis, and in these last it is generally an indication of a fatal termination. The mucous membrane becomes covered with numerous white spots, which are firmly adherent, and when removed a deep red colour is revealed. These patches appear mostly near the angle of the mouth, on the tongue, but may occur elsewhere in the oral cavity, the affection spreading at times to the pharynx and œsophagus. The spots are about the size of a pin's head, are circular, gradually coalesce, and form larger patches, giving rise to the appearance of a

false membrane, which has a slightly yellowish aspect. The membranes so formed come away of their own accord, leaving a reddish surface beneath. The patches are found to consist of epithelium and fat, together with sporules of the *oïdium albicans*, the vegetable parasite which causes the disease.

When thrush occurs in children they are generally found out of health, the bowels relaxed, the evacuations green and sour. The motions are generally acrid, and so irritate the margins of the anus, giving rise to an erythematous blush over the buttock, a condition of similar character to that in the mouth occupying the edges of the anus. Sucking and deglutition are impaired by the condition of the mouth, and the child will usually be in a state of drowsiness and torpor. Many cases of thrush in infants are distinctly traceable to the use of dirty feeding-bottles. It has been deemed by some authors that the *oïdium albicans* is the cause of thrush, other writers maintaining that the development of this vegetation is the result, not the cause, of the illness.

The treatment of thrush may be divided into local and general. The local consists in carefully wiping the mouth with soft lint after each meal, care being taken to burn the lint after use. The exposed surfaces thus left are touched with a solution of three drachms of borax to the ounce of water. In severer cases it will be advisable to use nitrate of silver, five grains to the ounce, or dilute carbolic acid in glycerine. It is needless to say that attention should be given to the condition of the feeding-bottle. The general treatment will consist in careful attention to the diet, with the administration of a mild aperient.

Follicular ulceration of the gums.—This inflammation is similar to an ordinary herpetic eruption, a cluster of vesicles first appearing, which on breaking down coalesce, and form a small, circular, and well-defined ulcer. This ulcer is surrounded by a zone of redness, and is extremely painful. They are said to occur more frequently near the frænum of the lip, on the under surface of the tongue, and in the sulcus between the gums and the lip. The little round punched-out ulcers met with in the

cheeks are probably a variety of this form. Follicular stomatitis occurs in children, and less frequently in adults; in these latter it is often associated with some slight disorder of the alimentary tract, such as dyspepsia.

The treatment consists in the application of an astringent solution, and in intractable cases the ulcers may be touched with a crystal of sulphate of copper or a little nitrate of silver. Mild purgation is also to be advised.

Ulcerative stomatitis.—This form of inflammation generally commences at the free margin of the gums, and is said to be more frequent in the upper jaw. In the early stages the gums are swollen and congested, the congested veins leading to this part being distinctly visible. The ulceration commencing at the free margin gradually spreads, denuding in its course the alveolus, and leading to necrosis of the teeth. The adjacent mucous surface of the cheek generally becomes attacked from contact, and if the case is left alone the ulceration may extend, leading to extensive necrosis, sloughing, and, ultimately, death of the patient. In well developed cases, an ulcer with sharp irregular edges is seen, the margin displaying a bluish ring, the ulcer being covered with a greyish or yellowish slough, and the neighbouring lymphatic glands being enlarged.

In the early stages there is but little pain, and the disease may be far advanced before it is discovered by the parents, and then the odour of the breath is the first point noticed. Children are more prone to suffer from ulcerative stomatitis, although it may occur in adults. The disease is predisposed to by anhygienic surroundings, and is also liable to occur after the exanthemata. The ulceration may attack both upper and lower gums simultaneously, and in some patients is liable to recur. It is also contagious where children are congregated together, and, in such places as an infirmary or school, it may attack large numbers of the inmates.

Treatment consists in administering internally some chlorate of potash, a drug which seems to be a specific for this disease. The dose should be about one grain to each year of the patient's

oedematous. At this stage, if the mouth be examined, an ulcer will be seen on the mucous surface of the cheek corresponding to the dark spot external. The ulceration, or rather sloughing, leads to perforation of the cheek, and if the disease still pursues its course the soft parts rapidly become gangrenous. The child becomes exhausted, delirious, and eventually dies of either exhaustion, blood poisoning, or some septic affection of the lungs.

The *prognosis* of cancrum oris is bad. The facts that the whole cheek becomes gangrenous, and that the disease is not amenable to the action of chlorate of potash, help to distinguish it from ulcerative stomatitis; but most authors agree that the difference between cancrum oris and ulcerative stomatitis is only one of degree. The disease is said to be caused by thrombosis of the capillaries, induced by the presence of a specific micro-organism, and is similar to the gangrenous inflammation known as noma, which occurs upon the female genitals.

The *treatment* consists in carefully drying the soft parts, removing all gangrenous portions, and cauterising the remaining surface with nitric acid, or the actual cautery. The general treatment will consist in supporting the patient's strength with a plentiful supply of beef tea, port wine, and other nutritious remedies. It has been suggested that free excision of the gangrenous surfaces would be an effective treatment, and in cases recorded it has proved beneficial. Corrosive sublimate locally applied has been used: it has proved successful in three cases recorded by Kingsford in *The Lancet* of May 4th, 1889. Disinfectant mouth-washes must be prescribed, and the raw surfaces carefully dressed with antiseptics, when extensive necrosis of the jaws occurs. The disease may so extend that the whole side of the face disappears, the cavity extending from the nose to the ear, and from the lips to the upper eyelid.

Syphilitic inflammation and ulceration.—Inflammatory trouble of the mucous membrane of the cheeks and gums occurs in both the so-called secondary and tertiary stages of syphilis. In the former the character of the inflammation is principally superficial; in the latter tubercular or gummatous. The superficial occurs in

weak, debilitated people, often followed by deep, unsymmetrical, and obstinate ulceration, which may lead to extensive destruction of tissue, followed on healing by adhesion of contiguous parts and extensive contraction. In the tertiary stages the ulcerations are generally of a deep excavated character, and are preceded by a gummatous swelling, which, undergoing degeneration, leads to the ulceration. The treatment of these is naturally that of syphilis.

Polypus of the gum.—Polypus of the gum is the name given to local hypertrophies of that tissue, the result of irritation. It is therefore generally found in connection with the ragged edge of a cavity or stump, and may be brought about by the presence of tartar or even irritation from a clasp or some other portion of an artificial denture. In character and microscopical appearance a polypus resembles the gum tissue. The growth really starts as a simple hypertrophy of the gum : this increases, becoming pedunculated, and, if the cause is not removed, may increase so as to simulate an "epulis"; but from this it can be distinguished by the fact that the epulis will be felt to spring from the periosteum, the polypus from the gum. When the polypus encroaches upon the cavity of a tooth it may grow so as to completely fill it, and when it has reached the surface of the cavity will come in contact with the opposing teeth, this often causing ulceration and great pain. In the cavity of a tooth the growth has to be diagnosed from a polypus of the pulp. This is not difficult, as in one case the pedicle of the growth will be in connection with the pulp chamber, while in the other it can be traced to the gum between the teeth. The polypus of the pulp is not painful to the touch, while that of the gum is generally exquisitely so.

The *treatment* consists in removing the source of irritation, but it is generally advisable to snip off the growth as well ; or, in the case where it is in connection with a cavity, it is sometimes useful to remove the growth with some potassa cum calce or with the actual or electrical cautery. The cervical margin of the cavity must be carefully trimmed and care taken to see that

the filling does not overlap at this point and so leave a source of irritation.

Fibroma.—The term epulis, which is used in connection with tumours of the gums, really means “a swelling on the gum.” Under this term some authors include all tumours that occur in this region—viz., fibrous, myeloid, epitheliomatous—designating them fibrous epulis, myeloid epulis, and so forth. Other writers limit the term to the fibrous variety.

A fibroma of the gum, or fibrous epulis, generally springs from the periosteum covering the septum between two contiguous teeth. These epulides are of slow growth, and by their pressure separate the adjacent teeth; but, when arising near a stump, they tend by their growth to completely cover it. In character they resemble the normal gum, and on examination will generally be found pedunculated. Some of these growths seem to spring from the anterior surface of the alveolus, and when this is the case the situation is usually the upper canine region. If the tumour grows so that it comes in contact with the opposing teeth ulceration may be set up, causing great pain; again, if an epulis is left untreated, it may assume large dimensions, so as to protrude from the mouth. A remarkable case of fibrous epulis occurred in the practice of Liston, and is referred to in Heath's work on *Injuries and Diseases of the Jaw*. In structure fibrous epulides are composed of bundles of fibrous tissue, and a few elastic fibres, and occasionally spicules of bone are found in the growth.

A point of some interest in connection with this class of epulis is that when a tooth is removed the growth often comes away with it, being apparently attached to the periosteum of the tooth. Fig. 305 is an illustration of such a case, and it is quite possible that the growth here is really a tumour of the dental periosteum. Epulides are said to be more common in women than men, and to occur most frequently between the upper lateral and canine at the junction of the intermaxillary with the maxillary bone, and this fact may be of some significance as to their origin at that position.

Treatment consists in removing the tumour, and taking especial care to cut away the portion of bone from which it

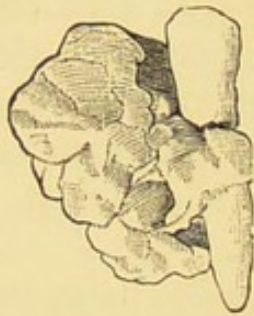


FIG. 305. Lower canine, with tumour adherent to the periosteum. From a case under the care of Mr. Truman.

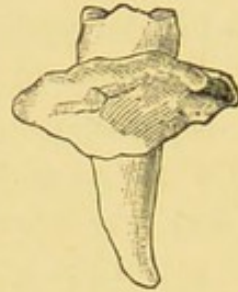


FIG. 306. Lower bicuspid, with tumour adherent to the periosteum. From a case under the care of Mr. Truman.

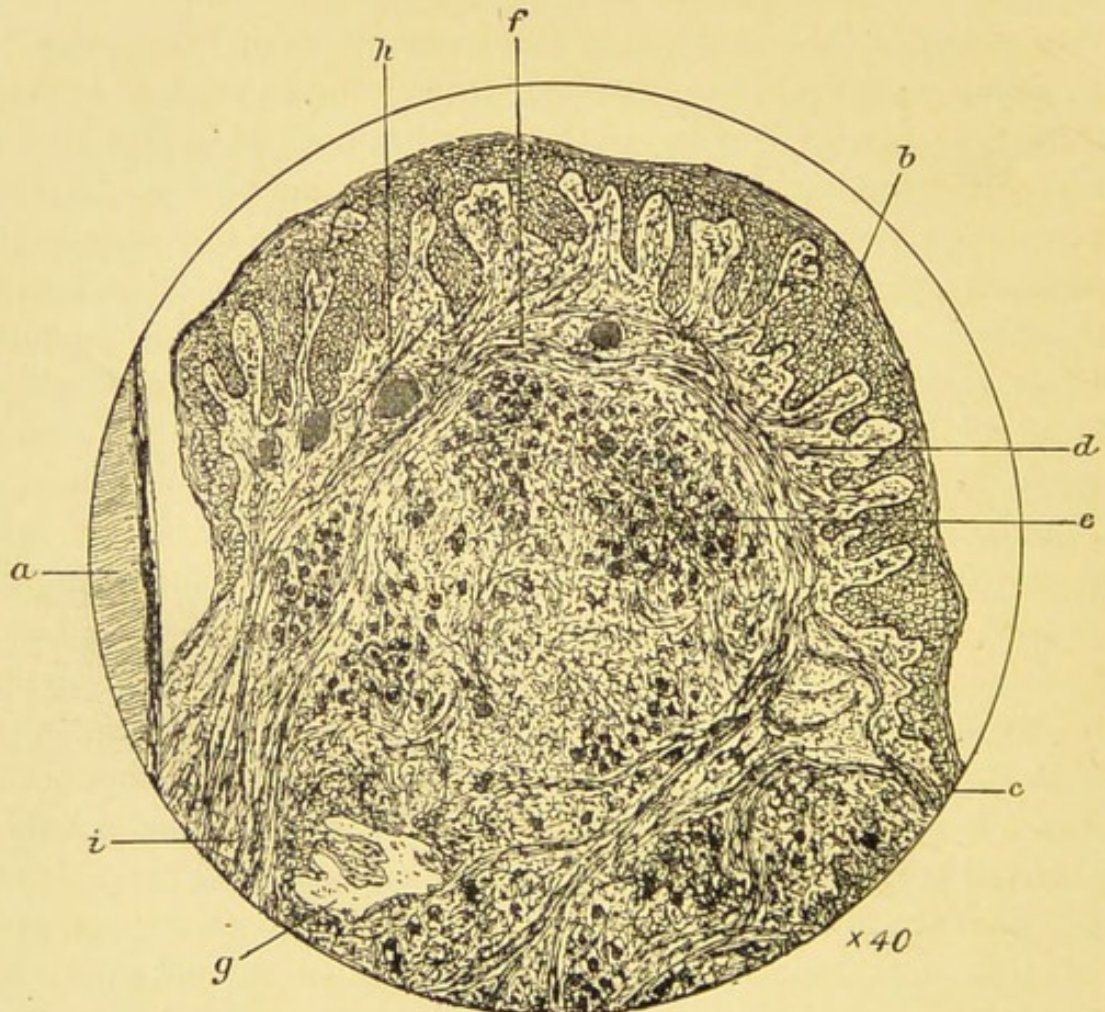


FIG. 307. Longitudinal section of a tumour similar in external appearance to figs. 305 and 306. (a) Dentine and cementum; (b) stratified epithelium; (c) basement membrane; (d) submucous tissue; (e) masses of giant cells; (f) fibrous septa; (g) nodule of bone; (h) spaces filled with colloid material; (i) attachment of tumour to cementum.

springs. The pedunculated part can be first removed, and then with suitable instruments, such as bone gouge, enamel chisels and coarse burs on the dental engine, the septum of bone between the teeth is cut away. Many surgeons recommend removal of one or both of the adjacent teeth at the same time, but this is not always needful. Many cases can be cured without this radical measure if care is taken in removing the septum of bone; but should the growth recur, then it would be better perhaps to sacrifice the tooth, the only reason for this being that it will allow the bone to be removed more efficiently. After removal the wound should be swabbed with chloride of zinc, and a mouth-wash containing some antiseptic given, chloride of zinc gr. iij. to water ℥i. being as valuable as any.

Myeloid sarcoma, or myeloid epulis, is not nearly so common as the fibrous variety. In character these epulides are softer, more vascular, have a dark grey colour, mottled with purple coloured spots, looking somewhat like a mulberry. They occur in young people, are quicker in their growth, and more frequently contain bone than the fibrous variety. In structure they are composed of a stroma of fibrous tissue, containing multi-nucleated or giant cells. Their origin is from the bone itself, viz., beneath the periosteum, and many of them, as pointed out by Heath, are really out-growths of myeloid tumours of the jaw.

The *treatment* consists in free removal, not only of the growth but of the adjacent bone; and naturally in these cases where the growth is part of more extended trouble, major operations, such as the removal of large portions of the bone, are indicated.

Papilloma.—Papillomata may be considered as very rare growths upon the gums. They arise from hypertrophy of the papilla of the gum. The growth presents all the appearance of papillomata in other parts of the body. In one recorded by Sir William Fergusson, the papillæ reached more than half an inch in length, resembling somewhat the filiform papillae of the tongue. In structure these tumours are seen to be principally composed of epithelium. The *treatment* indicated is to remove them by excision.

Vascular tumours.—These growths, which occasionally occur upon the gums, may simulate a capillary nœvus, in which case

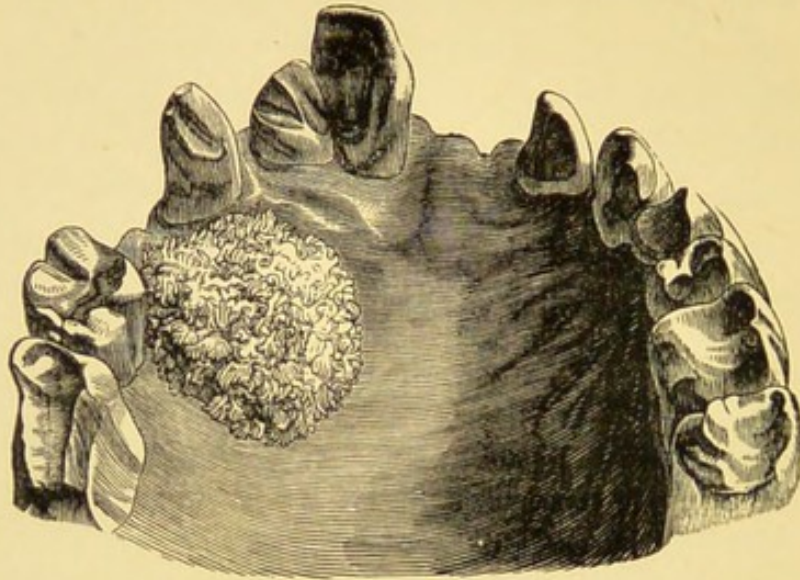


FIG. 308. Papilloma of the gum. (Heath.)

they are composed of dilated capillaries; or a venous nœvus, in which case they are composed of irregular spaces containing venous blood; or arterial nœvus, the irregular spaces in this case being filled with arterial blood.

The growth usually presents a smooth surface, differs in colour, being bright red in arterial to purple in venous nœvi, on pressure being applied they become pale, rapidly returning to their original condition after removal of the pressure. They are more common in the incisor region, though they may occur in that of the molars. Starting as a little red spot, they gradually spread between the teeth and extend principally along the margin of the gum, both in front and behind the tooth. These growths bleed readily when touched with the tooth-brush, and in one patient under notice the hæmorrhage was severe. In the case of distinct venous nœvi the tumour may attain to a large size, and involve the mucous membrane of the gum, cheek, and lip. The *treatment* of these cases belong to the domain of surgery, and the patient should be at once referred to a surgeon. (For the methods pursued in treatment the reader is referred to works on surgery.)

Epithelioma of the gums.—Epithelioma of the gums is generally of the squamous variety, although the columnar is at times seen attacking the lower jaw. When starting in the gums it is due to some long continued irritation, such as the ragged edge of a tooth or a badly fitting denture. The disease is insidious, and often its presence is only recognised by the fact that after extraction the socket of the tooth does not show any tendency to heal. The ulceration spreads, involving the adjacent tissues, and is characterised by eversion of the edges and induration of its base. In the upper jaw the growth of the epithelioma takes place principally in the direction of the antrum, so that the external appearances may be but slight. This class of tumour, when it tends to spread to the antrum, has been named “creeping epithelioma,” and is liable to be mistaken for necrosis of the jaw. As the disease extends, the lymphatic glands in the neighbourhood will become enlarged, the patient emaciated, with the characteristic cancerous cachexia, and, if the disease is untreated, death from asthenia will generally ensue. The early recognition of epithelioma is most important, and as it may come under the notice of dental practitioners in its early stages, its clinical signs should be thoroughly understood by them. All patients over 35 with ulceration of recent origin should receive close scrutiny. In doubtful cases, treatment for non-malignant ulceration may be tried; if this fails, the diagnosis may be cleared up by obtaining a microscopical section.

The *treatment* consists in freely excising the diseased parts; the success of the operation depends upon the thoroughness with which it is carried out, and no hesitation must be shown in resecting a portion of the lower jaw, or removing the maxilla if necessary.

Lead poisoning.—Chronic lead poisoning affects the gums in a very characteristic manner by causing a blue or slate-coloured line upon them. It is more frequently seen upon the lower than the upper gums and in the incisor more than the molar region. In addition to the blue line, other symptoms of lead poisoning will generally be present, such as colic and wrist drop, due to

paralysis of the extensor muscles of the wrist. In rare cases the blue line may be present and yet no other symptoms exist; under such conditions one should carefully eliminate other causes.

The *blue line* must be diagnosed from (1) a delicate line of blue found at the margin of the gums and teeth, but not involving the gum, and occurring in people exposed to white lead dust for a few hours. This deposit disappears on rinsing the mouth, and is only lead sulphide deposited upon, and not in, the substance of the gum. (2) A deposit under the margin of the gum, occurring in patients who clean their teeth with charcoal. (3) A deposit similar to (2) occurring in people exposed to carbon dust, such as miners. (4) The line caused by copper and bismuth poisoning. (5) A blue line caused by a thin layer of black tartar. It must be noted that the line is absent if teeth are not present, and also it is more marked when there is present a source of irritation round the necks of the teeth, such as tartar. After treatment, by removing the patient from his surroundings, the line disappears, generally within a period of three or four weeks, or, in more severe cases, in three months or longer.

The inner side of the cheek opposite often shows discoloured patches of mucous membrane, varying to about the size of a shilling.

Actinomycosis.—An excellent resumé of this disease was given by Mr. Eve at a meeting of the Odontological Society in 1888. He describes the disease when attacking the maxillary region as follows:—"It often begins with severe pain, localised in one or more teeth, which are frequently carious. A swelling appears about the lower, or less commonly the upper, jaw, in the cheek or near the angle of the jaw. This usually softens and suppurates, the abscesses opening at many points, and giving rise to numerous intercommunicating fistulæ." The disease rapidly spreads, and involves contiguous parts. Microscopic examination of the discharge will show the characteristic ray fungus, and, should the disease be recognised, operative measures must be adopted; these include incision into the

affected parts, followed by thorough scraping with sharp spoons.

Ranula.—Though not strictly belonging to this section, it may be useful here to refer to this affection. Ranula is the name given to a cyst in the floor of the mouth; it gives rise to a semi-translucent, bluish swelling, containing a glairy mucoid fluid. It was formerly considered to be due to blocking of Wharton's duct, but more recent investigations have proved it to be connected with the mucous follicles, a ranula being probably analogous to mucous cysts found in other parts of the mucous tracts. The facts that a ranula never contains saliva or any fluid that can be formed from saliva; that by excitation of the salivary glands the secretion of these organs can be seen flowing from their ducts; and that Wharton's duct can be traced on the wall of the cyst, and a bristle inserted into its orifice, tend pretty conclusively to exclude its connection with Wharton's duct. The *treatment* is to take up with a pair of forceps the upper surface of the cyst and excise a good piece with a pair of curved scissors; this in small cysts will be sufficient to bring about a cure, while larger ones will require to be plugged.

CHAPTER XII.

SALIVA AND SALIVARY CALCULUS.

SALIVA is the secretion of the salivary glands. In the mouth the secretion of the various glands are mixed. Saliva is a viscid fluid, containing air bubbles, which render it frothy. It has a specific gravity of 1·002 to 1·006, and when recently collected is colourless, but upon standing becomes slightly turbid. Its reaction in health is alkaline. Chemically it is composed of water and ·5 per cent. solids, namely, "ptyalin," a peculiar ferment which converts starch into sugar, mucin, globulin, serum albumin, salivary corpuscles, salts, including—(a) phosphates of lime and magnesia and sodium, (b) chlorides of sodium and potassium, (c) carbonates of lime and magnesia, (d) a trace of sulpho-cyanate of potassium; as found in the mouth, it is mixed with débris of food, epithelial scales and micro-organisms. The secretion from the parotid gland is clear and watery, and on standing a deposit is thrown down consisting principally of carbonate of lime. The submaxillary saliva is thick, viscid, contains mucin, and on standing deposits the chlorides of potassium and sodium. The sublingual glands are important, as being the principal source of ptyalin; their secretion also contains phosphate with a small amount of the carbonate of lime. From one to three pints of saliva are said to be secreted during the day, and of this quantity about two-thirds are secreted by the parotid, and one-twentieth by the submaxillary gland. Saliva has both mechanical and chemical uses. Amongst the former may be cited—

(1) It keeps the mouth moist, and therefore assists the movements of the tongue in speaking, and also the mastication of the food ; (2) by dissolving substances it excites the nerves of taste ; (3) it assists in the formation of the bolus, making it easy for deglutition ; (4) it is important in its relation to the sense of hearing by causing constant swallowing, and therefore opening the Eustachian tube through the tension of the tensor palati muscle, so allowing air to reach the tympanum and equalising the pressure upon both sides of the membrana tympani ; (5) it stimulates the flow of the gastric juice. Chemically it converts a small portion of the starches into sugar, so preparing them for digestion.

It should be distinctly remembered that the salivary glands of children do not become functionally active until four to six months old, and hence starchy food of all sorts must be avoided. In rare instances¹ there may be a complete absence of saliva.

The careful study of the condition of the saliva in health and disease is one that, as far as the authors can discover, has not yet been made ; but, nevertheless, seems one which would provide many useful results, and the analysis of saliva in disease might often be used as a confirmatory test in suspected disease. Certain diseases alter the character of the secretion of saliva. In some acute fevers and inflammation the secretion is considerably diminished, the mucus rapidly undergoes fermentation, and, clinging about the teeth, becomes hardened by evaporation of the fluid portions and gives rise to "sordes." In small-pox salivation is sometimes seen, while in diabetes, according to M. Cehl, sugar is present. In acute dyspepsia the saliva is often acid.

In the *Philosophical Transactions*, vol. B, p. 180, for 1889, there is an important communication made before the Royal Society by Messrs. Langley and Fletcher, "On the Secretion of Saliva." Their chief results are summarised as follows:—There is an increase in the percentage of salts, with an increase in the rate of secretion. Slowly secreted saliva contains a low percentage of salts, whether it is produced by either weak or strong nerve

¹ *Dental Cosmos*, vol. xxi.

stimulus to the chorda tympani nerve. Stimulation of the sympathetic nerve, on the other hand, produces a saliva with a higher percentage of salts. Sublingual saliva has a considerably higher percentage of salts than submaxillary saliva. If lithium citrate, potassium iodide, potassium ferrocyanide, and pilocarpine are injected into the blood, lithium can be detected in the first drop of saliva secreted, iodine after the first six drops; potassium ferrocyanide cannot be detected at any stage of secretion. Dyspnoea and obstructed flow of blood through the gland decreases the rate of flow and increases the percentage of salts. Salivary calculus is also the name given to those concretions which are met with occasionally in the ducts leading from the salivary glands. The solid portions of the saliva are frequently deposited upon the teeth, and in addition to extraneous matter, this substance is called salivary calculus, or "tartar." Tartar, according to Berzelius, is composed as follows:—

Phosphates of lime and magnesia,	-	-	79·0
Salivary mucus,	-	-	12·5
Ptyalin,	-	-	1·0
Animal matter soluble in HCl,	-	-	7·5
			100·0

This can only be approximate, and in the hard varieties Dr. Stevenson gives the following:—

	Water and Organic Matter.	Salts.
Soft tartar,	- - - 21·48	78·52
Hard tartar,	- - - 17·51	82·49

Tartar collects principally upon the lingual sides of the lower incisors and canines, and the buccal surfaces of the upper molars; in this latter situation there is a large proportion of carbonate of lime. It can be divided into various classes, but these are purely arbitrary and depend upon the colour; for instance, buff-coloured, brown, green, are all described. The most useful classification is probably into hard and soft. The hard is generally dark in colour, slowly deposited in small quantities, and is exceedingly tenacious; the soft is light-coloured, quickly deposited, and

capable of more easy removal. In the mouths of smokers the tartar or deposit upon the teeth is generally black, due to staining from tobacco smoke. The green discoloration so frequently seen upon the teeth of the young is probably not tartar at all. It is more often met with upon the upper and lower incisors, is more marked towards the cervical margins, and is more common in dirty mouths. It is probably a pigmented condition of Nasmyth's membrane, or even a carious condition of that tissue. This view is supported by the fact that when once removed it does not return. The hard dark rim of tartar, often seen in quite clean mouths, and situated under cover of the gum, is probably not a deposit from the saliva at all but from the glands situate in the neighbourhood of the necks of the teeth. The deposit found in pyorrhœa alveolaris is probably also derived from the discharges.

Deposits of salivary calculus are favoured by (1) rough surfaces, such as are seen upon "honeycombed teeth"; (2) the presence of foreign bodies, such as wires or clasps in dentures which are not removed from the mouth for the purpose of cleansing; (3) the existence of pockets around the gums, such as occur in affections of the periosteum. The deposit generally starts at the cervical margin and increases in quantity by additions to its base, presenting a thin edge towards the gum, so that a section of a piece of tartar would present a wedge shape, the base being towards the tooth. The deposits may reach a large size, and be mistaken for a tumour. Tartar is frequently seen on teeth not utilised in mastication, and is generally due to the presence of tender teeth causing the patient to avoid mastication on that side. The presence of the deposit upon teeth leads to more or less absorption of the alveolus and in many cases to chronic inflammation of the gums. It may also cause ulceration of the tongue, cheek, or lips.

The experiments of Langley and Fletcher assist to explain the deposit of salivary calculus as tartar upon the teeth; to account in some measure for the position in which it is so deposited; and also point to the possibility of morbid materials

in the blood being found in the salivary secretion, and forming part of either tartar upon the teeth or being present in a salivary calculus deposited in the duct of a salivary gland. The presence of tartar upon painful teeth may also be accounted for by the fact that a nerve stimulus increases not only the flow but also the percentage of salts in the saliva, and may explain in some measure the deposit of tartar often found upon upper molar teeth when these teeth are decayed and painful. Diseases which produce dyspnoea and obstruction of the flow of blood through the gland would give rise to an increase of the deposit of tartar, from the fact that in such conditions the percentage of salts is increased. That sublingual saliva should contain a high percentage of salts may to some extent account for the position in which the greatest amount of tartar is found.

Treatment.—The treatment of salivary calculus consists in thoroughly removing all the deposit and polishing the surfaces of the teeth. For effecting the removal, a large spoon-shaped excavator or curved enamel chisel may be used in addition to specially designed instruments, and of these Cushing's and Howes' sets are useful forms. The force for detaching the deposit may be used in any direction, towards the gum or the reverse. The former is the best when there is much tartar, the latter when the quantity is small. When using the force in a direction towards the gum, the right hand should be steadied by placing a finger or fingers upon the teeth, the cutting edge of the instrument being placed upon the tartar, and a pushing motion used, when the tartar will be found to come off in large flakes; by this means the greater part of the tartar can be taken away, the remaining adherent portions being removed in a direction from below upwards, the instrument being prevented from slipping by supporting the hand on the cutting surface of the teeth. When there is much deposit it will often be necessary to see the patient more than once, as it is quite impossible to remove every portion at the first sitting. At the completion of the scaling, the teeth must be polished with fine pumice applied by means of a circular brush on the dental engine.

In carefully-kept mouths, however, no tartar should be found ; and properly shaped tooth-brushes should be recommended, that will allow of both the front and back surfaces of the teeth being thoroughly cleansed, together with the free use of a crow-quill tooth-pick, and floss-silk for the proper cleansing of the contiguous surfaces of the teeth and for the removal of all foreign bodies likely to act as a point for the deposit of tartar.

Salivary calculus, instead of collecting upon the teeth, may be deposited either in the ducts of a salivary gland or in the glands themselves ; but this latter is very rare, for should a deposit take place in the substance of the gland, it usually becomes washed into the duct. When, however, the deposits are found in the substance of the gland, they give rise to serious inflammatory trouble ; the flow of the saliva from the duct of such gland is obstructed, the trouble leading perhaps to abscess or even destruction of the gland. When a salivary calculus is deposited in the duct of a gland, the obstruction, which may be either as small as a millet seed or larger than a filbert, will give rise to a swelling of the duct and gland. Salivary calculi found on the floor of the mouth may simulate ranula, from which it is important to diagnose them ; this can be done by noting that in the case of salivary calculus the flow of saliva is stopped, and that a salivary probe cannot be passed along the duct, while careful digital examination will reveal a hard concretion in the duct.

Treatment consists in making an incision over the hard swelling, and removing the calculus. It is best to secure the concretion in a fixed position before making the incision. Cases remaining untreated may give rise to either abscess in the region of the duct or in the gland itself. The abscess at times opens externally, and thus gives rise to a salivary fistula.

CHAPTER XIII.

ODONTOMES.

AN odontome has been defined by Bland Sutton as “a neoplasm composed of dental tissues in varying proportions and different degrees of development, arising from tooth germs or teeth still in the process of growth.” Professor Broca (*Traité des Tumeurs*, 1869), who has paid much attention to this subject, has divided or classified them under four headings :—

- (1) “Odontomes embryoplastiques,” or those arising during the early stages of development before the membrana eboris is formed.
- (2) “Odontomes odontoplastiques,” or those arising after the formation of the membrana eboris and the formative elements of the enamel.
- (3) “Odontomes coronaires,” or those arising during the formation of the crown of the tooth.
- (4) “Odontomes radiculaires,” or those arising subsequently to the completion of the crown, and therefore only causing a deformity of the root.

Bland Sutton, who has more recently investigated the subject, and has had numerous opportunities of studying it in the lower animals, prefers the following classification, based upon the tissues concerned in the formation of the tooth, viz. :—

- (A) Aberrations of the enamel organ.
Epithelial odontomes.

- (B) Aberrations of the follicle.
- (1) Follicular or dentigerous cysts.
 - (2) Fibrous odontomes.
 - (3) Cementomata.
 - (4) Compound follicular odontomes.
- (C) Aberrations of the papilla.
- Radicular odontomes.
- (D) Aberrations of the whole tooth-germ.
- Composite odontomes.

This latter classification will be adhered to in the following pages.

(A) ABERRATIONS OF THE ENAMEL ORGAN.

Epithelial odontomes.—These odontomes are supposed to have their origin in aberration of the enamel germs. According to Sutton, “most of the patients come under observation at the age of about twenty years, although the disease may occur at any period from infancy to old age. More commonly the lower jaw is affected, and the molar region is usually, though not exclusively, involved.

“In typical specimens the tumour displays on section congeries of cysts, very various in size, but rarely exceeding an inch in diameter. The cysts are separated by thin, fibrous septa, in some cases by osseous tissue. The cavities are, as a rule, filled with mucoid fluid of a brownish colour. The growing portions of the tumour are of a reddish-brown colour, not unlike that of a myeloid sarcoma.

“Histologically, these tumours are composed of branching and anastomosing rods or columns of epithelium, portions of which form alveoli. The stroma is composed of fibrous tissue; when abundant, embryonic tissue in various stages is present. The cells occupying the alveoli vary in form; the outer layer may be columnar, whilst the central cells degenerate, and give rise to a reticulum of stellate cells resembling in structure the stratum

intermedium of the enamel organ."¹ The appearance of these tumours is shown in fig. 309.

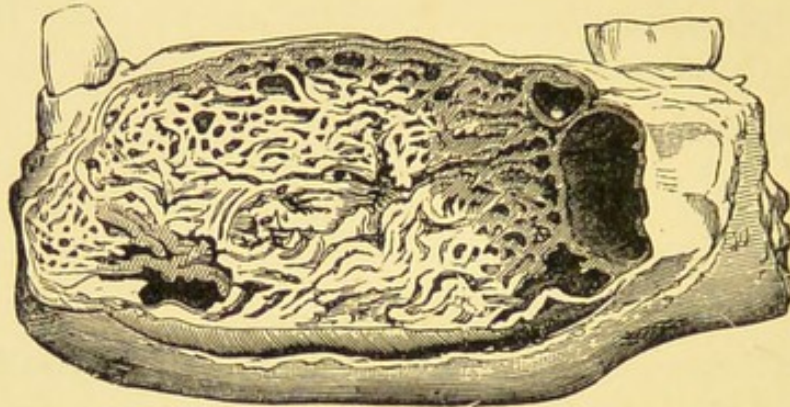


FIG. 309. From the *Transactions of the Odontological Society*.

Epithelial odontomes are analogous to the cystic sarcomas of older writers. Mr. Eve was the first to draw attention to the real nature of these growths, and termed them "multilocular cystic epithelial tumours," a name since adopted by Mr. Heath in the latest edition of his work on *Injuries and Diseases of the Jaws*. In describing the septa of this form of odontomes it will be noticed that they are at times ossified; if this ossification extends so that the greater part of the tumour is affected, we then have a *calcified epithelial odontome*. A tumour apparently belonging to this class has been described by Mr. C. Tomes in the *Transactions of the Odontological Society*, vol. xviii. p. 62.

(B) ABERRATIONS OF THE FOLLICLE.

These odontomes include those arising in connection with the tooth follicle or sac. If the abnormality consists in an excessive secretion between the developing tooth and the follicle wall, a follicular odontome or dentigerous cyst is the result. If, on the other hand, the aberration consists in considerable hypertrophy of the follicle wall (which is fibrous in structure), a fibrous odontome arises, and should this thickened wall undergo calcification, we get a cementoma. The function of the follicle is to

¹ *Trans. Odontological Society*, vol. xx. p. 35.

form cementum; it is therefore natural that, should the thickened capsule calcify, the resulting tissue will be cementum. The thickened wall, however, may not calcify *en masse*, but rather in a sporadic manner; in such cases the tumour may be

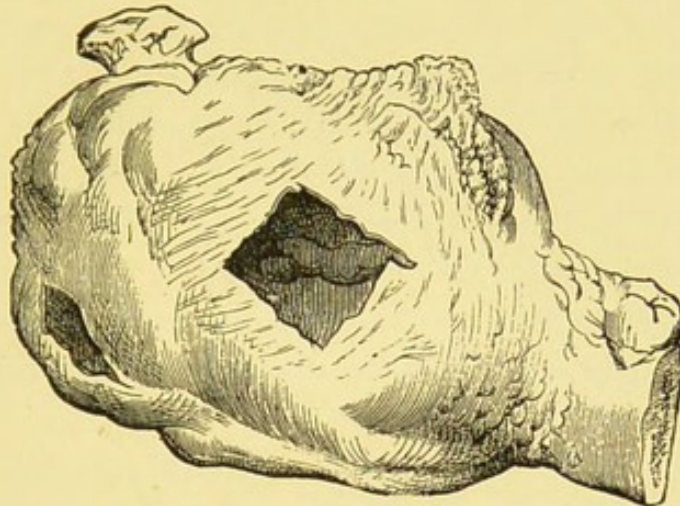


FIG. 310. Part of a lower jaw enormously distended by a cyst, which probably originated in the enamel organ of an abortive wisdom tooth.

composed in greater part of small denticles composed of bone cementum, or badly-formed teeth. When this condition takes place, a compound follicular odontome is the result.

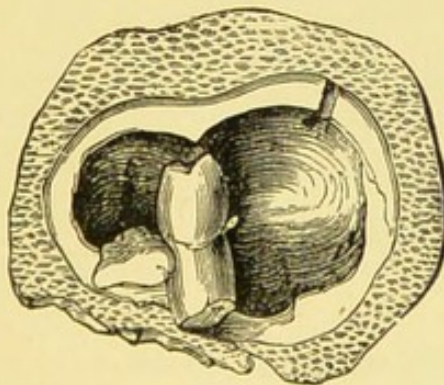


FIG. 311. Follicular cyst, containing a bicuspid tooth with a well-formed crown and truncated root (*Transactions of the Odontological Society*).

(1) **Follicular odontomes.**—Follicular odontome is the name proposed by Sutton for that class of cyst previously known as dentigerous cyst. These cysts or follicular odontomes are

met with in connection with unerupted or retained teeth, and are produced by an excessive secretion of fluid between the enamel and the follicle. They are said to be more frequent in the molar region, and but rarely occur in connection with the temporary teeth; but cases of this latter are recorded, as well as one in which a supernumerary tooth was the seat of mischief. Clinically, they give rise to slowly growing swellings, which in the lower jaw cause the plates of the mandible to expand, thus simulating an innocent solid growth. In the upper jaw they frequently invade the antrum, causing a bulging of the various walls. The walls of follicular odontomes or dentigerous cysts are formed by fibrous tissue; as the cyst increases in size it naturally causes the contiguous bone to be absorbed, while externally additional tissue is deposited.

The contents of the cyst consist of a fluid of a glairy character, a tooth also being nearly always present. This tooth is frequently inverted and generally incompletely formed. It may either project into the cavity of the cyst or may lie quite loose on the floor. The walls of follicular odontomes or dentigerous cysts are very prone to undergo calcification, the bone formed resembling that of the alveolar border. In addition to this change in the walls the cyst may suppurate. This condition is commoner in the lower animals. In man it is of great interest, because dentigerous cysts undergoing this change become frequently so altered in character as to simulate more serious diseases, and on more than one occasion large portions of the jaw have been removed for apparently malignant disease where a suppurating dentigerous cyst has been found to be the cause of the tumour.

(2) **Fibrous odontomes.**—The tooth sac, as is well known, is composed towards its external portions of fibrous tissue. If this become hypertrophied we get a fibrous odontome. Fig. 312 gives a good idea of the character of these odontomes. The thickened follicle, examined microscopically, is found to be laminated in character and composed of fibrous tissue, presenting at times a certain amount of ossification. These odontomes, when occurring

in the lower animals, are generally symmetrical, and in one case, that of a dasyure, the skeleton was softened by rickets;

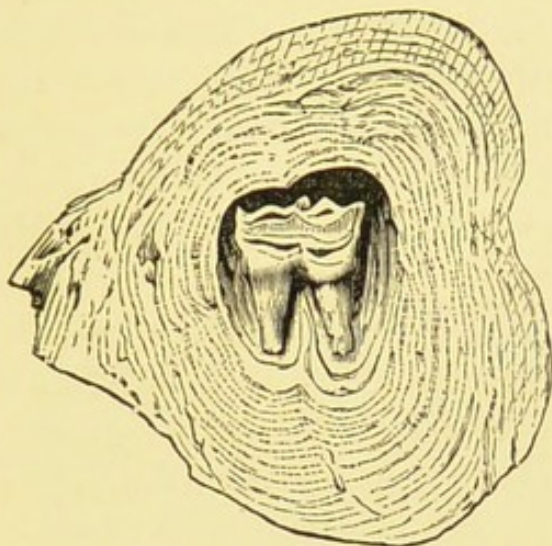


FIG. 312. From the *Transactions of the Odontological Society*.

this, combined with the fact that rickets seems to thicken the membranes covering growing bone, tends to show that there may be a connection between this class of odontomes and rickets.

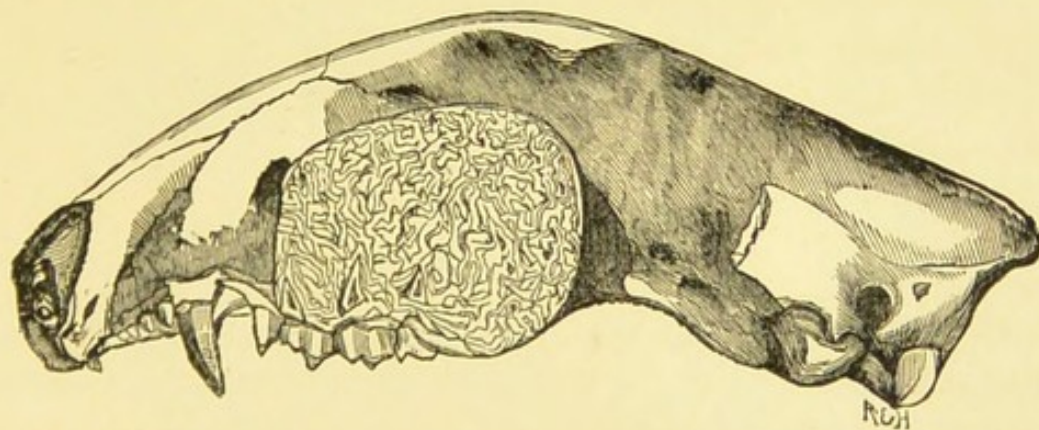


FIG. 313. Portion of the skull of a dasyure, showing a fibrous odontome in section. The tumour was intimately connected with a molar tooth. From the *Transactions of the Odontological Society*.

Bland Sutton contends that many of the fibroid and fibro-cellular tumours recorded in Heath's *Injuries and Diseases of the Jaws* are really examples of this form of odontome.

(3) **Cementomata.**—These odontomes are produced by the ossification of practically fibrous odontomes, the resulting tissue being cementum. They are rare in man but common in horses and ruminants. In structure the tumour resembles cementum, and by its growth causes a hard tumour of the jaw; it is generally painless, but eventually may give rise to pain which is likely to be mistaken for periostitis or necrosis. Fig. 314 is the drawing of a cementoma recorded by Dr. Forget;

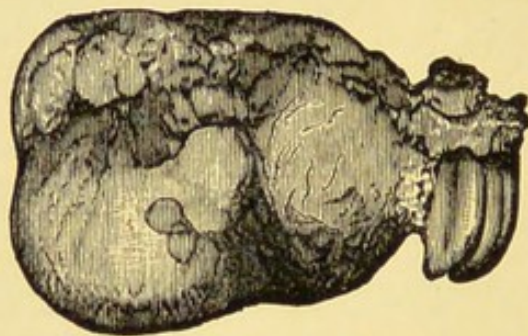


FIG. 314. From the *Transactions of the Odontological Society*.

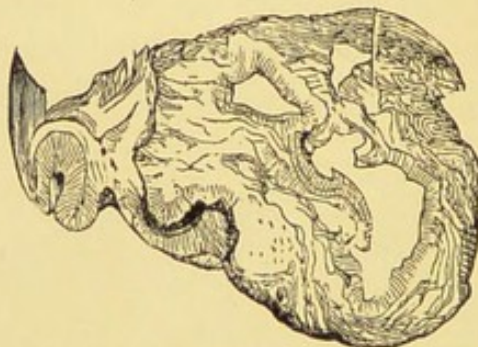


FIG. 315. Section through fig. 314. From the *Transactions of the Odontological Society*.

the odontome was about the size of a pigeon's egg and came away with a decayed molar, which he decided to extract before operating for the tumour.

(4) **Compound follicular odontomes.**—Under this heading are included those cases of cyst which contain large numbers of small masses of dental tissues, and in some cases bone. A few instances of this character have been reported in man, while Logan has recorded one in a horse and Bland Sutton one in a thar. The tumour presents in man all the appearance of a simple

follicular odontome or dentigerous cyst. More than one tooth is generally absent. For instance, in the case recorded by Zellander, a molar, two bicuspid, and a canine were absent; in the one recorded by Sir John Tomes, the central and lateral incisors; and in that which occurred in the practice of Mr. Sims, the right lateral incisor and canine were not in place.

The contents of the cyst vary somewhat in shape. Some of the masses present the appearance of supernumerary teeth, others are caniniform in shape. Sometimes the denticles are united together by cementum, while in addition irregular masses of bone also occur. Some of the denticles are multicuspid, and one found

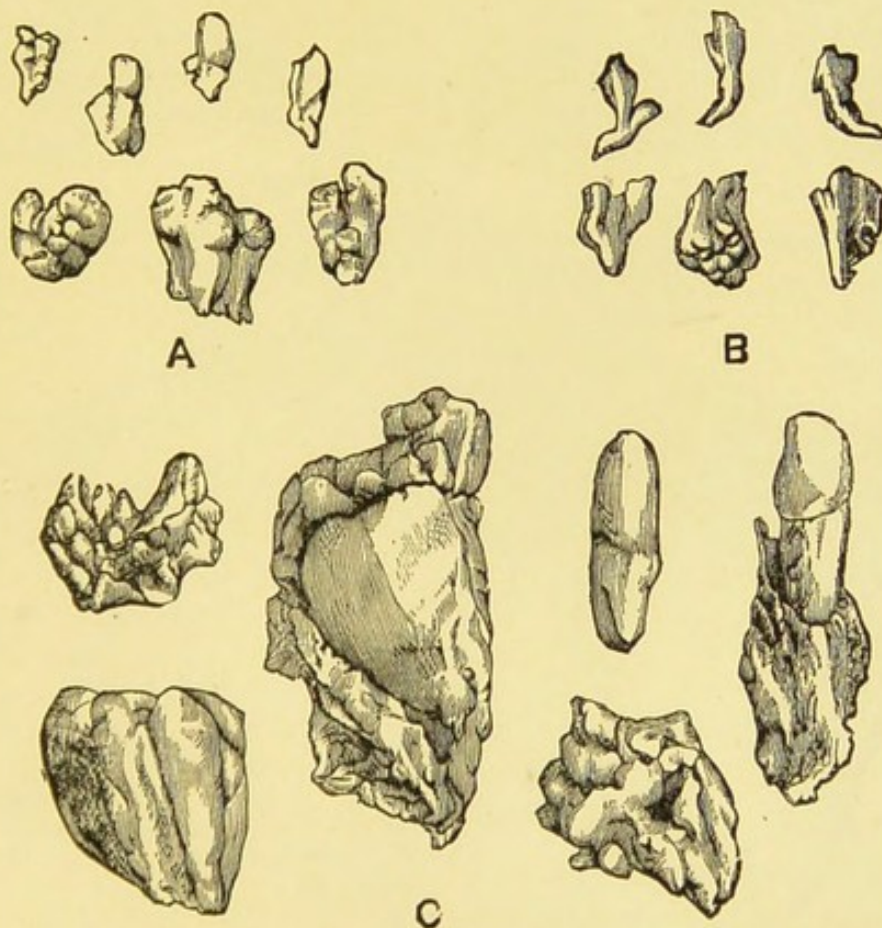


FIG. 316. From the *Transactions of the Odontological Society*.

in the cyst which occurred in the practice of Mr. Sims possessed as many as fourteen cusps. In fig. 316 will be seen drawings of some of the contents of these cysts.

In the case already referred to which occurred in the thar an opportunity was afforded of studying this class of odontomes in the recent state. Bland Sutton describes the condition he

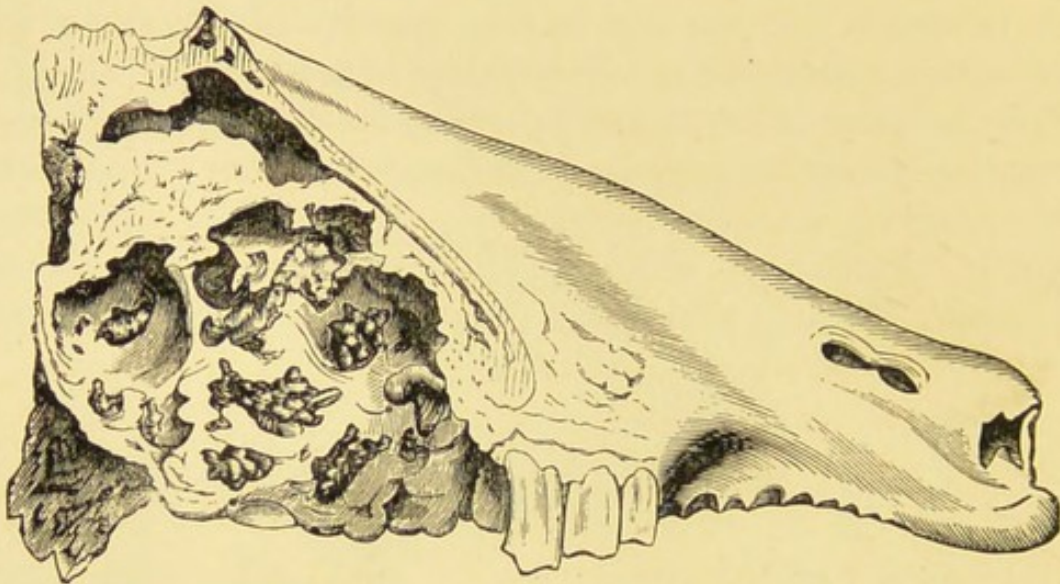


FIG. 317. Sagittal section of the right maxilla of a thar, showing the cyst *in situ*.
From the *Transactions of the Odontological Society*.

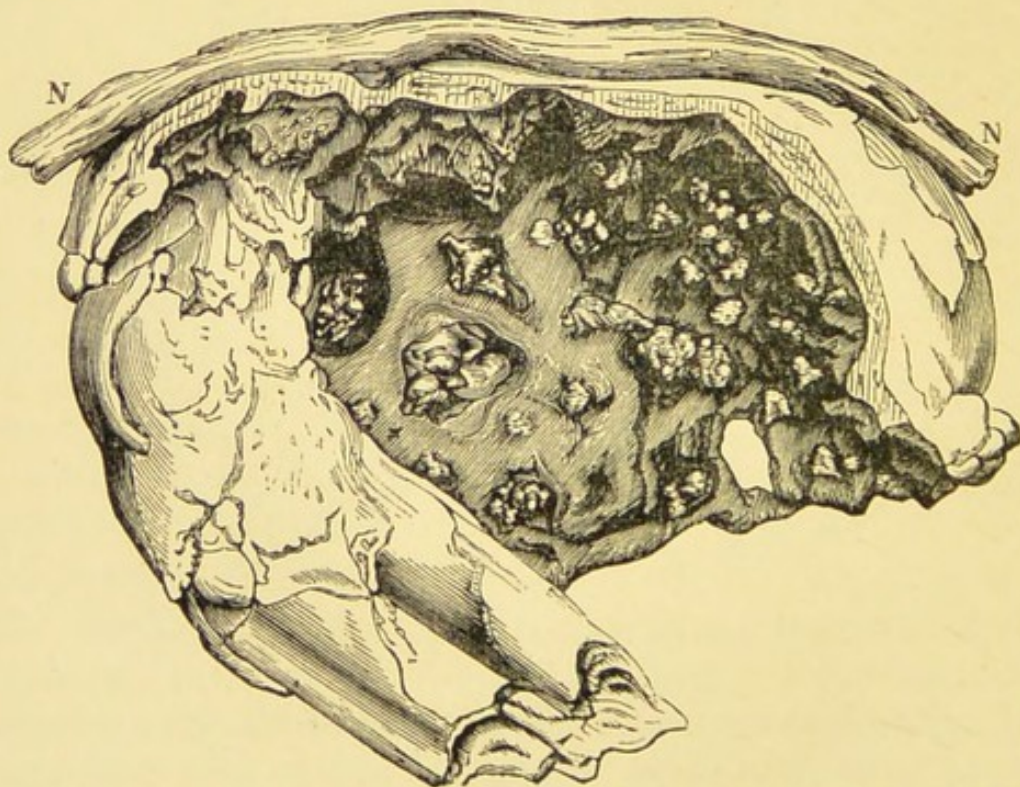


FIG. 318. N. The maxillary division of the fifth nerve. From the *Transactions of the Odontological Society*.

found as follows:—"Each antrum contained, in fact, a cyst with dense thick walls. The outer shell was of bone, lined with thick fibrous tissue. The interior was occupied with denticles, fragments of cementum, and bone of varying shapes and sizes, amounting to nearly three hundred. Those in the middle of the cyst were glued together by thick pus mixed with hay and chaff, whilst the peripheral fragments were embedded in fibrous tissue or sprouted from the cyst wall" (figs. 317 and 318).

(C) ABERRATIONS OF THE PAPILLA.

Radicular odontomes, which are included under this heading, arise after the completion of the crown and during the formation of the root. The specimen shown in fig. 319 will give a good

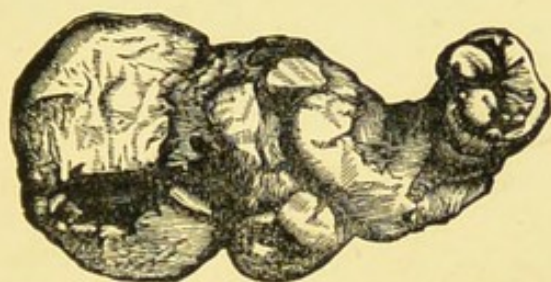


FIG. 319. From the *Transactions of the Odontological Society*.

idea of this form of odontome. A classification of radicular odontomes may be made as follows:—(a) Radicular dentoma; (b) radicular osteo-dentoma; (c) radicular cementoma. In the first, dentine is the principal constituent of the growth; in the second, osteo-dentine; and in the third, cementum.

Radicular odontomes are not common in man, but are met with more frequently in the lower animals, more especially those whose teeth are of persistent growth, such as rodents; they are also found in the incisor teeth of elephants. In man, odontomes nearly always occur in the lower jaw. Such is not the case in the lower animals, as they are by no means uncommon in the upper. Still further, in man they are never multiple, while in animals this condition sometimes obtains.

(D) ABERRATIONS OF THE WHOLE TOOTH GERM.

Composite odontomes, which are included under this division, in appearance have no resemblance to teeth, but look like irregularly-shaped masses of calcified tissue. Such tumours, on section, are found to be composed of enamel, dentine, and cementum, disposed in apparently no definite arrangement. A good example of this class of odontome was removed by Mr. Heath, and is shown in fig. 320. As belonging to this category may be quoted



FIG. 320. Composite odontome. (Heath.)

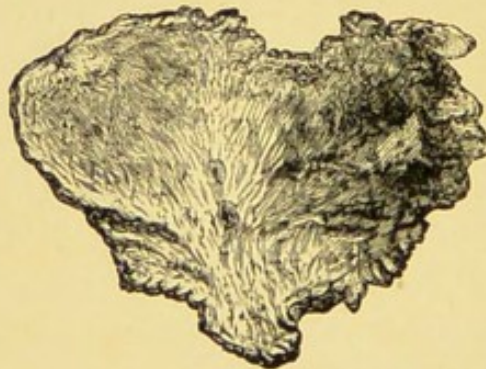


FIG. 321. Section through fig. 320. (Heath.)

the well-known case of Dr. Forget, where the odontome with the surrounding portion of the jaw was removed. An illustration of the odontome *in situ* is shown in fig. 322.

Symptoms and treatment.—The train of symptoms arising from

the presence of odontomes will naturally vary according to the type present.

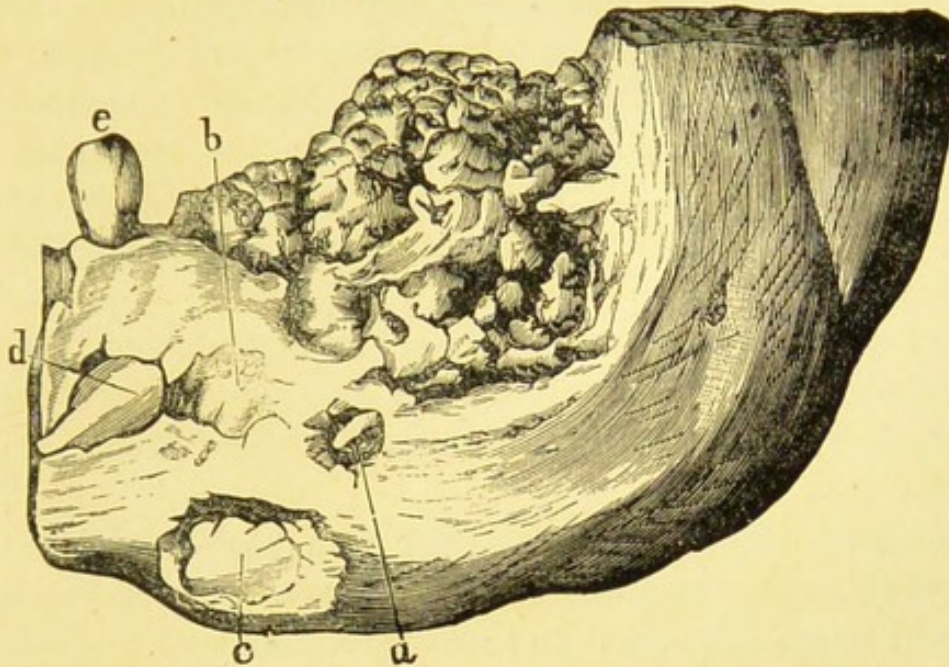


FIG. 322. A composite odontome *in situ*. (After Forget.) (a) and (b) Portions of odontome; (c) first molar; (d) second bicuspid; (e) first bicuspid.

The epithelial odontomes give rise to slow and painless expansion of the plates of bone of the jaw. The character of the swelling is often lobulated, and may therefore be mistaken for a myeloid sarcoma. In conjunction with the swelling will be the absence of one or more teeth. The treatment consists in opening up the cyst with suitable instruments, taking care to break down all the loculi. The cavity must then be packed with lint or tape dipped in carbolic acid 1 in 20 solution. This assists in the destruction of any remaining cyst wall, and promotes the formation of granulations, which in time completely close on the cavity.¹

Follicular odontomes give rise to slow-growing tumours, painless in character; but should suppuration supervene, the pain may become severe. There is generally an absence of a tooth or teeth from the series, though not always, as the cyst may

¹ For the details of dressing, the student is referred to the treatment of chronic abscess.

form around a supernumerary one. The differential diagnosis must be made from epithelial odontomes, dental cyst, and chronic abscess. Treatment consists in freely opening up the cyst and evacuating its contents, care being taken to search for the tooth. The cavity is then plugged with lint dipped in carbolic acid 1 in 20, and treated subsequently similarly to a chronic abscess.

Fibrous odontomes give rise to slow, painless distension of the lower jaw, and are likely to be mistaken for ordinary fibromata of the jaw.

Radicular odontomes are not likely to be diagnosed previously to the attempt to remove the tooth, and it is only when undue resistance to extraction is met with that their presence is suspected.

Composite odontomes during their growth give rise to no painful symptoms, but eventually like teeth seem to pass through an eruptive stage. Suppuration then takes place, and the odontome is likely to be mistaken for a more serious disease of the jaw. This probably happened in the case under the care of M. Forget. In all cases of the slightest doubt, before undertaking so serious an operation as excision of the jaw, a preliminary incision should be made.

CHAPTER XIV.

REPLANTATION, TRANSPLANTATION, AND IMPLANTATION OF THE TEETH.

REPLANTATION is an operation which consists in replacing in its socket a tooth which has been partially or completely dislocated.

Transplantation is the operation of transferring a tooth from its own socket to that of another tooth. The transference may take place in the same mouth, or the tooth may be extracted from the mouth of one person and transferred to that of another.

Implantation is an operation consisting in the formation of an artificial socket in the maxillary bone for the introduction of a natural tooth.

Of these three operations, the only one to any extent performed in this country is replantation, the other two, namely, implantation and transplantation, being of questionable utility.

Replantation.—The *conditions* under which this operation may be performed are for (1) traumatic dislocation, and (2) obstinate cases of chronic periodontitis.

The *operation*, in the first instance, consists in gently rinsing the tooth in a solution of some antiseptic (Hydrarg. perchlor. 1 in 2000), and replacing it in the socket with firm pressure, the alveolus being moulded around it with the fingers. The tooth may be kept in place by a piece of silk twist, encircling the replanted tooth with its neighbour, but in some instances a small vulcanite splint is valuable. If the patient is not seen until the

lapse of hours after the accident, the pulp must be removed, and the canal filled before replacing the tooth.

When the operation is performed for chronic periodontitis, a different procedure is recommended by those who perform it. The tooth, after being extracted, must be held in a piece of lint dipped in some antiseptic, the canals being thoroughly cleaned, rendered aseptic, and filled. Any existing roughness about the apex of the tooth should be removed, and any diseased periosteum scraped away. The socket must then be rinsed with an antiseptic, and the tooth, having been rendered aseptic, should be replaced with firm pressure. The after-treatment consists in keeping the parts quite clean by frequently washing the mouth with antiseptic and astringent mouth-washes.

The *union* after replantation is brought about through the periodontal membrane. In cases where the tooth is living and is immediately replaced, a re-establishment of the vitality of the pulp is sometimes produced. Magitot, who has recorded a large number of cases of replantation, maintains that, for success, there must be a complete ring of healthy membrane on the tooth.

The *results of replantation* depend upon the nature of the conditions for which the operation is undertaken. If for traumatism, and the tooth is immediately replaced, a permanent result may be looked for; but, on the other hand, if replacement is delayed, the prognosis is naturally not so good. In cases of periosteal mischief no very permanent result can be looked for, and a period of five or six years is perhaps beyond the average duration of the tooth in the mouth. The tooth, during the period of retention, is nearly always a source of trouble, being tender and loose. Teeth which have been removed after replantation show marks of absorption, generally in irregular patches on their surfaces.

Transplantation.—This operation was performed in days gone by far more than at the present date; but it is still interesting, if only for the recollection of the remarkable experiments carried out in connection with it by John Hunter.

According to Coleman, there are three distinct objections to the operation—(1) The liability to failure; (2) the chance of inoculation; (3) the moral objection. Failure of the operation may be due to (*a*) want of adaptability of the tooth to its new socket; (*b*) morbid conditions of the new socket; (*c*) applying ligatures to keep the transplanted tooth steady. The chance of inoculation of disease is most important, and, within recent times, a case of transmission of syphilis has been recorded. This objection to the operation is probably far more cogent now than in former times on account of the great advance in knowledge as to the influence of germs in the causation of disease. The moral objection to the operation is also weighty, as, naturally, the teeth to be transplanted are usually obtained from the poorer classes. All considered, transplantation is an operation to be condemned where there is a transference of a tooth from one patient to another, and the only condition where it may be considered justifiable is in a case of irregularity, where perhaps a sound lateral has erupted within the arch and the central is badly carious.

The method recommended for carrying out transplantation is as follows:—The patient to have the transplanted tooth is first operated upon, as little injury as possible being inflicted, and the bleeding from the socket arrested if possible. The tooth to be transplanted is next removed from the other patient and immediately transferred to the vacant socket.

Union in transplanation may be similar to that which takes place in replantation, or the process may be entirely different and similar to that occurring in implantation, viz., absorption of the transplanted tooth first taking place in various situations. In these excavations bony tissue is formed, continuous with the alveolus. In other cases it seems possible that there is only a fibrous union.

Implantation.—This is an operation of more recent date than the two first described, but is one which is probably less justifiable even than transplantation. Dr. Younger, who was the first to perform this operation, is very particular in the choice of

his patients, selecting only young and healthy subjects. The teeth to be implanted should possess healthy periosteum.

The method of procedure is as follows:—A crucial incision is made over the situation intended for the implanted tooth; the flaps of periosteum are then dissected up, and by means of specially-designed trephines and burrs a fresh socket is made. The socket is then syringed so as to remove all débris, and after this the bleeding is arrested with cold water, the tooth being fixed into place and, if necessary, secured with ligatures or other suitable means. The root canal of the implanted tooth is, previously to insertion, filled with gutta percha, the apex of the root being finished with gold. Dr. Younger, to perform implantation, does not necessarily use freshly-extracted teeth, but employs in some cases dry teeth. The union, taking place after implantation, is probably similar to that following many cases of transplantation, viz., absorption of the tooth and a subsequent ingrowth from the socket. The results obtained from implantation are not encouraging, and do not justify the operation.

CHAPTER XV.

THE OPERATION OF EXTRACTION OF THE TEETH.

THE operation of extracting is one which requires skill, judgment, experience, and an accurate anatomical knowledge of the parts involved; and to ensure success the following points must be carefully attended to, viz. :—(1) To carry out the operation completely, that is, to remove the tooth in its entirety; (2) to avoid undue injury to the surrounding parts; (3) to inflict as little pain as possible on the patient. Like all other manipulative proceedings, success can only be obtained by actual practice.

For facility of description, the operation will be considered under the following heads :—

- (1) Extraction in general.
- (2) Extraction of individual teeth and stumps.
- (3) Extraction under anæsthetics.
- (4) Complications, difficulties, etc.

(1) **Extraction in general.**—One of the first points to claim attention is the great importance of clean instruments. It is perfectly true that the proper employment of antiseptics in the mouth is difficult, still it is beyond doubt that all instruments, whether probes, forceps, or the like, should be rendered aseptic by dipping the points of the probes or the beaks of the forceps into boiling water both before and after using. Careful attention to this point cannot be too fully emphasised, for the conveyance of venereal disease by means of dirty forceps is certainly unpardonable.

The position of the patient and operator is of great importance. The patient should assume such a posture as to allow the operator not only perfect control over the tooth and movements of the head, but also to permit him to exert his force to the greatest advantage. Generally speaking, for lower teeth the patient should be as low as possible, while for upper ones the position should be such that the operator can with comfort encircle the patient's head with his left arm if necessary. The chin and head should be kept, if anything, slightly forward when extracting lower teeth; while for upper teeth it should be inclined more or less backwards according to the position of the tooth in the head. With regard to the position of the operator, when removing lower teeth on the right side with hawk's-bill forceps he should stand behind and to the right of the patient, the left arm should be brought round the left side of the head, at the same time the first finger of the same hand should be placed along the outer side of the alveolus, the thumb along the inner, and the remaining three fingers below the jaw (fig. 323).



FIG. 323.

In placing the fingers in the mouth care must be taken to keep the wrist well down so as not to impede the entrance of light. A certain amount of control over the head is thus obtained with the left arm ; by keeping away the tongue and the cheek with the first finger and thumb a clear view of the tooth is ensured ; and the fingers below the jaw counteract the downward pressure, and so considerably increase the effectiveness of the right hand. In removing teeth on the left side of the lower jaw with hawk's-bill forceps the operator should stand on the right side and slightly in front of the patient, the first and second fingers of the left hand should be placed in the mouth (one on either side of the alveolus), and the thumb kept below the jaw to counteract the downward pressure (fig. 324). For extracting upper teeth the



FIG. 324.

operator should be on the right side of the patient, the first finger and thumb of the left hand being placed on either side of the alveolus (fig. 325).



FIG. 325.

For extracting teeth, either forceps or elevators are used. The main points about forceps are, that they should be made of fine steel, should not be too heavy in manufacture, possessing just enough strength to withstand the force applied, and that the edges should accurately fit the neck of the tooth for which they are intended.

When applied, the blades should just clear the crown of the tooth, and the terminal edges should be thin, so that on section, each blade presents a thin wedge. The straighter the forceps the better, for they are more readily controlled, and if there is a curve in the blades, it is better, if possible, to have a curve in the handle in the opposite direction. It should be remembered

that the greater the surface over which the pressure is diffused, the less risk there is of fracture when effecting the removal.

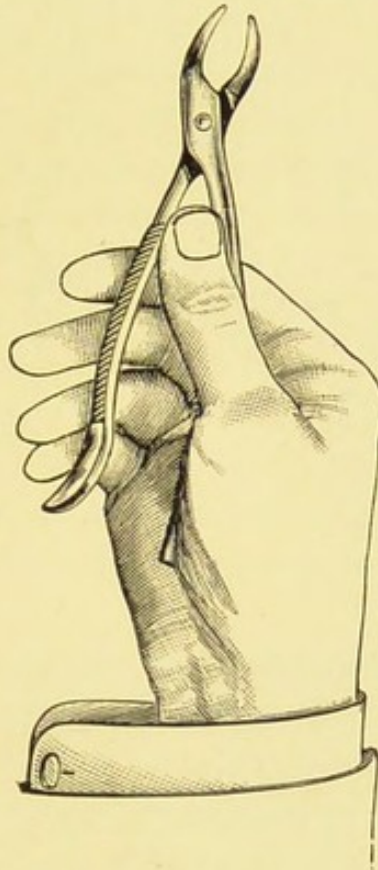


FIG. 326. Showing manner of holding an upper pair of forceps.

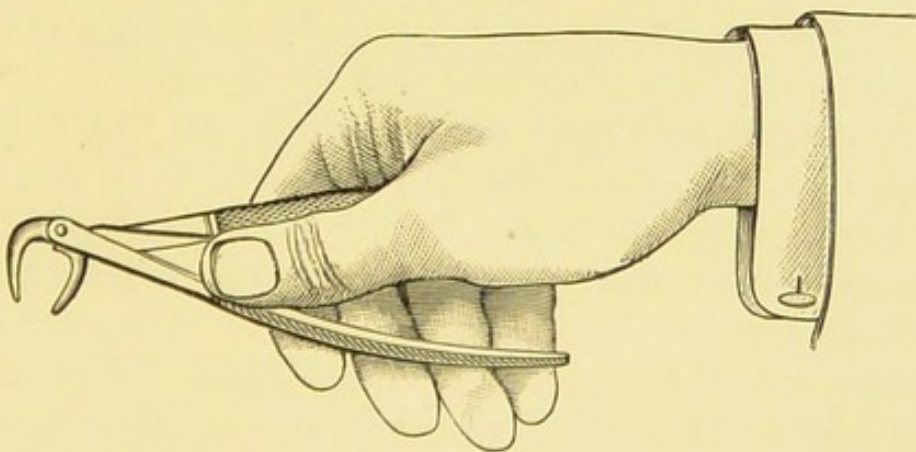


FIG. 327. Showing manner of holding a lower pair of forceps.

Forceps should be held as shown in figs. 326 and 327, and a point of great importance is to keep the thumb between the two

handles, as nothing can form a better regulator for controlling the amount of power applied to the blades. The elevator should be held as shown in fig. 328. The use of having the first finger

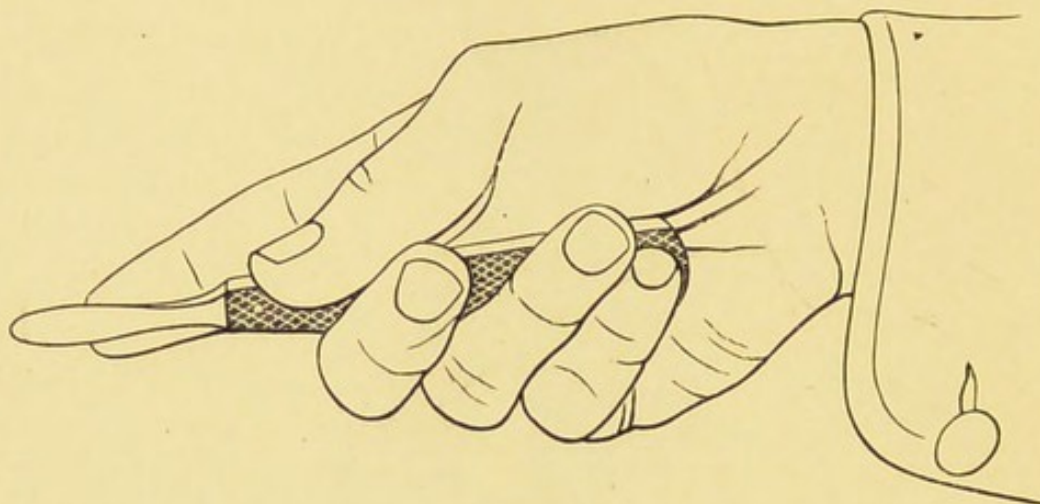


FIG. 328.

near the tip of the instrument is to prevent any serious damage to the soft parts should the instrument slip. When using forceps, Sir John Tomes divides the steps of the operation into three stages:—(1) Seizure of the tooth, (2) destruction of its membranous connection with the socket, (3) removal of the tooth from the socket. The first stage is brought about by holding the forceps as previously advised, and applying one blade to the side of the tooth most obscured from view, and then closing the other blade upon the opposite side.

A point to which great attention should be paid is "to be sure to get the edges of the blades between the gum and tooth," thus avoiding the inclusion of any portion of gum. The blades being in position, the next step is to forcibly press up or down (as the case may be), in the direction of the root of the tooth, and it will be found useful to give the blades at the same time a slight lateral motion, practically speaking, to wriggle them into position. The amount of pressure to be applied will vary according to the tooth to be extracted and the resistance of the alveolus, and requires careful judgment; the force, as before mentioned, is best regulated by the joint action of the fingers

and thumb. The tooth being seized, the next step is to sever its membranous connection, and in doing this, either rotation is employed, that is, a slight, steady turn is given to the tooth, or lateral motion, viz., the tooth is moved in an inward and outward direction. The movement employed naturally depends upon the shape of the roots of the teeth, those permitting of rotation being the upper incisors and the lower bicuspid.

Practically connected with this stage is the third and final, viz., removal of the tooth from its socket. In carrying out this, extractive force should be exerted in the direction of the long axis of the tooth and also in that of the least resistance, and, as the outer alveolar plate is generally the thinner, it is nearly always in an outward direction. The direction of least resistance is determined, not only by a correct knowledge of the anatomy of the part, but also from the sensation conveyed to the hand through the forceps.

The wound after extraction generally heals by granulation; it is therefore useful, if many teeth have been removed, to advise the patient to rinse the mouth thoroughly and frequently with some antiseptic mouth-wash, the following prescription being useful.

R.	Liq. pot.,	}	-	-	-	-	-	-	āā	ʒiv.
	Acid carbolic,									
	Aquam ad									ʒiv.
M.	One teaspoonful in half a tumbler of water.									

A point of some importance is to become accustomed to the use of as few forceps as possible; by this means the operator learns not only to use them with greater precision, but also to operate more quickly, since change of forceps necessarily means loss of time.

(2) **Extraction of individual teeth and stumps.**—Central incisors, upper.—The roots of these teeth are practically tapering cones, the anterior surface being the arc of a greater arch than the posterior. The blades of forceps for their removal should, therefore, be made upon the same principle. In applying the instruments great care must be taken to get the blades between the gum and the

teeth, as the less the soft tissues are injured the less the subsequent absorption takes place. It is better to apply the lingual blade first, and then the labial one. Rotation is generally adopted as the loosening movement for these teeth, but it will be found that one in an inward direction, viz., towards the back of the mouth, will be better. This was first suggested by Mr. Ewbank, and is well worthy of trial. If rotation is used it should not approach anything like a quarter of a circle, and the movement should be of a steady character. Should the tooth fail to yield to the above movements a lateral movement, viz., antero-posteriorly, may be adopted. When the tooth is severed from its attachments extractive force in a downward direction will usually suffice for its removal from the socket.

Cuspidati, upper.—Forceps of a stronger character than those used for incisors should be employed, but the movements for extraction are practically similar to those made in the case of incisor teeth, with the exception that the cuspidati do not readily admit of rotation, the root, as a rule, being of a rounded triangular character.

Upper Bicuspids.—For these teeth the blades of the forceps should be of equal length, and straight. First and sometimes second bicuspids can be removed by forceps similar to those used for extracting incisors. In extracting these teeth the inner blade is first applied and then the outer, the loosening movement required should be in a lateral direction, and it is best first to take them slightly inwards and then outwards, at the same time using downward force. Bicuspids are very often treacherous teeth to extract, especially the first one, since its root is nearly always divided, the bifurcations being very slender and fragile. Great care should therefore be exercised in their removal.

Upper Molars.—Special forceps are required for either side. The outer blades should possess two grooves, of which the anterior should be the larger and in a plane external to the posterior. A curve in the handles and blades of these forceps will make them more serviceable. There should be one groove

on the lingual blade to fit the base of the palatine root. In using these forceps it is advisable to apply the outer blade accurately to the base of the buccal fangs, taking as a guide the small fissure on the buccal surface of the molar as the place where the point of the forceps shall be placed. In removing molars it is best to loosen the palatine blade first, and to employ loosening movement first slightly inwards so as to disengage the roots from the external alveolus, and afterwards downwards and outwards in the axis of the internal root.

Upper Wisdom Teeth.—One pair of forceps, as a rule, will suffice for both sides, the blades for all practical purposes being equal, that is, arcs of the same circle. The upper curvature of these instruments should place the blades in a plane more posterior to the handles than is the case with ordinary molar forceps.

Under no circumstances should the elevator be used for the extraction of an upper wisdom tooth, on account of the danger such a proceeding would give rise to of fracturing the tuberosity of the maxilla or even the palate bone.

Lower incisors and cuspidati.—The roots of the lower front teeth are flattened laterally and will not, therefore, permit of rotatory movement. The loosening movement required is in an upward and outward direction. These teeth seldom require extraction until they become loosened by the absorption of their alveoli, or rarely for regulation cases; hence practice in their removal is very limited.

Lower bicuspid.—Forceps of the same pattern as used for incisors can be employed. Lower bicuspid are typical teeth for rotation, and in their removal great care must be exercised, since they are liable to shoot up between the blades of the forceps and pass into the throat of the patient. Should fracture of these teeth occur, the root, owing to the thickness of the alveolus, will be found, as a rule, extremely difficult to remove.

Lower molars.—For the extraction of these teeth hawk's-bill forceps are generally used, as they possess greater power than straight instruments, and allow a clearer view of the tooth to be obtained during the operation. The blades of lower molar

forceps should possess two grooves made of the same size, so that one pair of forceps will do for both sides. When extracting these teeth the lingual blade is generally applied before the buccal one, and the tooth removed with a force applied at first slightly inwards and then outwards. The roots of lower molars are frequently curved in a backward direction; when this is the case it is needful when raising the tooth from the socket to take it in a slightly curved direction backwards.

Lower Wisdom Teeth.—For these teeth no better instrument than an elevator can be used, if the second molar is standing. These roots curve backwards (considerably so in some cases), therefore the extracting movement should be in the arc of the same circle as that formed by the roots. This movement is very difficult to obtain with forceps, but very easy with an elevator. This instrument is used as follows:—Hold it as shown in fig. 328 and thrust the blade down between the tooth and the alveolus that separates it from its neighbour, keeping the handle in a direction upwards, outwards, and forwards, the fingers of the left hand being employed to keep the tongue and cheek out of the way. The handle is now depressed with a slight rotatory movement, causing the tooth to be raised in its socket. One depression of the handle is sometimes not sufficient, in which case the elevator must be raised again, so as to allow the point to impinge against a lower part of the tooth, and the handle again depressed, this movement being repeated until the tooth is completely raised. Sometimes when using the elevator, the gum adheres to the posterior part of the tooth; when this is the case, the lancet or a pair of curved scissors must be used for the completion of the operation.

When the wisdom tooth is standing by itself, the thumb can be used as a fulcrum, or forceps may be employed. It may be as well to mention in this place the fact that certain accidents may happen in using the elevator, for example, it may slip and injure the floor of the mouth or the tongue, and in one case, the ranine artery was wounded in using an elevator

for the extraction of a lower incisor; or the second molar may be fractured.

Upper roots.—Roots, being either cylindrical or flattened in shape, necessarily admit of both rotation and lateral movement. Especial care should be taken to apply the forceps well between the alveolus and the root, to press up more than is the case when removing a nearly sound tooth, and to be more cautious when carrying out the loosening and extractive movements. Upper incisors and cuspidate roots require rotation for their removal; bicuspid, lateral motion; and molars, when the three roots are united, inward and outward movement, when separate, simply rotation.

With regard to the removal of molars when all the roots are connected, a few words must be said. Whenever a molar which has the slightest appearance of being liable to fracture is met with, the best way will be to treat it as a root, using root forceps, since a better hold may be obtained with them. The inner blade should be applied to the palatine root, and the outer to the strongest of the buccal ones. By this means the three roots are frequently removed together, and failing that, nearly always two of them, the remaining root causing but little trouble in its removal. At times considerable difficulty is found in extracting teeth in this condition, especially after a recent fracture. In these cases, instruments which are specially constructed for dividing buccal roots will be found useful. After applying the dividing forceps, the extractive movement for a molar should be employed, when the root frequently comes away *en bloc*; but should this manœuvre not succeed, increased pressure must be applied, in order to separate the two external roots with the cutting blade, after which the forceps will, as a rule, grip the palatine root so that it will be brought away in the forceps, the two buccal roots being easily removed afterwards with a pair of ordinary upper stump forceps.

Lower stumps of incisors and bicuspid present, as a rule, little difficulty, the former admitting of lateral movement, and the latter of rotation.

Stumps of lower molars, when the roots are divided, are also easily extracted with a similar instrument to that used for the anterior teeth, lateral motion being used. When, however, the roots are joined together, more care must be exercised, and the same rule holds good as with upper molars, viz., if there is any chance of the root or tooth fracturing it should be removed with stump forceps, the blades being applied to either side of the strongest root, and in this way it will often bring away the two roots together. Should, however, only one root be extracted, the other can easily be removed by either placing an elevator behind it, and so forcing it into the socket of the extracted root, or by placing a curved elevator down the socket of the extracted one, forcing it through the septum, and then elevating the remaining root.

Temporary teeth.—Incisors and canines may be extracted with an instrument similar in pattern to those used for permanent teeth, but slightly smaller. In extracting the stumps of temporary molars considerable care must be exercised, since they are by no means of the simplest form; and should they be fractured too great persistence in efforts at removal is undesirable, since there will be danger of injuring the unerupted bicuspid. Roots are often met with in the condition shown in fig. 9, their presence causing ulceration on the gum and cheek. The removal of these is best carried out with a straight elevator, the instrument being applied to the end of the root, and so removing it.

(3) **Extraction under anæsthetics.**—The anæsthetics usually employed in dental surgery are nitrous oxide and ether. Of these the first is the best and safest, the only disadvantage in its use being the shortness of the period of unconsciousness it produces. No allusion, however, will be made in the ensuing remarks to their administration, but special points will be touched upon which are needful for the operator to bear in mind when employing their aid. The *position of the patient* will differ but little if at all from those before advocated, but special care should be taken not to place the head too far back. Before commencing, the operator

should decide what he has to do, and be doubly careful in examining the edges of stumps, etc., taking special precaution, however, not to prick the gum, and cause bleeding. The order in which he intends to remove the teeth (if there is more than one) should also be settled, and if any special tooth is causing trouble that should be extracted first. As a rule, however, lower teeth should be removed before upper ones, since, if the latter are extracted first, the bleeding may obscure the lower teeth. For similar reasons stumps should be extracted before teeth. Back teeth should also be extracted before anterior ones, to avoid the blood flowing backwards and obscuring the field of operation.

The shape and position of the mouth prop is of importance. Those made of plain vulcanite are undoubtedly best. They should always be placed, when possible, on the opposite side of the mouth to that to be operated upon; they should not be placed in front, on account of the liability to dislocate the incisors; and the mouth should not be opened too widely. Before commencing the administration of the anæsthetic it is well to take a final view of the relations of the teeth, prop, and tongue to one another and to see that artificial dentures have been removed. When operating the tooth should never be lost sight of, and no attempt should be made to proceed until it has been removed from the mouth. When using the same pair of forceps for the removal of several teeth, the previous root or tooth can easily be removed from the blades by wiping both sides on a napkin placed over the patient's shoulder. The liability of the tooth to slip from the forceps and pass down the throat should be kept in mind, and in removing teeth which are liable to shoot between the blades of the instrument, it is a good plan to place a finger of the left hand behind the forceps, and so avoid any chance of the tooth taking an untoward direction. In removing wisdom teeth, especially the lower, the gum often sticks to the back of the tooth. Should this happen, and more teeth have to be removed, the tooth may be quite safely left and cut away from the gum when the patient is conscious.

(4) **Difficulties, complications, and sequelæ.**—Under this heading it is proposed to consider the various difficulties, etc., that are met with in the operation of extraction, and though there are some which simply require mention, still there are others on which a few remarks with regard to treatment, etc., will be found useful.

- (a) Difficulties, complications, etc., connected with the teeth themselves.
- (b) Difficulties, complications, etc., connected with the jaws.
- (c) Difficulties, complications, etc., connected with the soft parts.
- (d) Complications, etc., connected with certain reflex actions and diatheses.
- (e) Accidents under anæsthetics.

(a) DIFFICULTIES, COMPLICATIONS, ETC., CONNECTED WITH THE
TEETH THEMSELVES.

(i.) *Resistance of the tooth and alveolus.*—One of the commonest difficulties met with will be great difficulty in effecting a movement of the tooth in its socket, and the amount of force which should be used in such cases will tax the judgment and skill to the utmost. Yellowish-coloured teeth, those with short thick crowns, and those isolated for some time most frequently give trouble. The cause of the resistance may depend upon either abnormal conditions of the teeth themselves, such as exostosed, divergent and twisted roots, fusion of one or more roots together, or upon abnormal density of the alveolar process. In such cases, too much force should not be used, as misfortune in some shape is likely to follow. If after repeated efforts to effect removal failure occurs, it is best to send the patients away, telling them that if the tooth still continues to give trouble to return within a few days; by that time the attempt at extraction will in all probability have set up some inflammation, which will have led to increased pliability of the alveolus and alveolo-dental membrane, so allowing the parts to yield to the efforts made on the second visit.

(ii.) *Fracture.*—The principal causes of this accident are, not getting the blades well up between the tooth and alveolus, the use of too much pressure, or badly-fitting forceps. The same deformities, etc., which give rise to the preceding difficulty are also predisposing causes to fracture. When this accident happens, before attempting to remove the fractured portion, the mouth should be thoroughly rinsed, the socket of the tooth dried out with pledgets of cotton-wool, and the edges defined with a probe. Should the endeavours to remove the fragment prove futile it will be better to leave it, treating the patient on similar lines as mentioned under the previous heading. Should the fragment contain an exposed nerve a little strong carbolic or nitric acid will be found to bring great relief. It is both right and expedient to inform the patient that a fracture has occurred and what will be its probable consequences.

Crowded and irregular teeth will often be found extremely difficult to remove, and this is especially the case with the lower incisors. This difficulty may sometimes be overcome by grasping the tooth sideways, using forceps with very narrow blades or by employing a special pattern with a narrow anterior or posterior blade as the case may require. Great care must be exercised in their use on account of the tendency of the narrow blade to act as a cutting forceps. Partially erupted teeth at times give trouble. Forceps with thin blades are the best to use for these, but it sometimes becomes needful to remove a portion of the alveolus before proceeding to extract. Impacted teeth necessarily are difficult to remove, but each individual case must be treated on its own merits.

(iii.) *Removal of the wrong teeth.*—This may happen, and the treatment is to replace the tooth immediately and instruct the patient to keep the mouth closed, or better, apply a four-tailed bandage.

(iv.) *Accidental removal of a neighbouring tooth* may also occur. When extracting, and the neighbouring tooth is found to be moving, the thumb must be placed upon it during the operation and its removal prevented.

(v.) *Removal of a bicuspid* with the root of the temporary molar is sometimes due to inserting the blades too deeply, but in some cases the accident is unavoidable. Still, in extracting temporary molars, attention should be paid to the depth the blades are inserted. In taking out these teeth, especially when carious, fracture often occurs, and in persistent attempts to extract the roots, the bicuspid has been removed.

(b) DIFFICULTIES AND COMPLICATIONS CONNECTED WITH
THE JAWS.

(i.) *Fracture.*—Fracture of a small portion of the alveolus occurs frequently, the fragment at times adhering to the tooth and coming away with it. This is not always due to the blade of the forceps being inserted outside the margin of the alveolus instead of between it and the tooth. It is an accident usually of very little importance, although it may lead to necrosis. Fracture of a large portion of the alveolus is of graver consequence, often leading to death of the exposed teeth and necrosis of the part fractured. Mr. Salter¹ records a case in which, while endeavouring to remove an upper central incisor, the bone was fractured along the line corresponding to that separating the intermaxillary from the maxillary bone and along a horizontal line at the base of the nose. No bad result, however, followed; the fractured bone united, and the tooth was cut off level with the alveolus to allow the wearing of an artificial substitute. Such favourable results do not always follow; and in a patient who came under treatment at the Dental Hospital of London an operator, not connected with that institution, in endeavouring to remove a first lower molar, had fractured the alveolus along the level of the apices of the teeth, so that a portion of bone containing the bicuspids, cuspids, and incisors was detached and held only by the soft parts. A gutta-percha splint was made and every attention paid to cleansing the wound; necrosis nevertheless supervened, the teeth being eventually lost.

¹ *Brit. Jour. Dental Science*, vol. xiv. p. 160.

Mr. Cattlin¹ also relates a case where, in an attempt to extract a broken upper wisdom tooth with the elevator, the instrument slipped and broke away the tuberosity of the superior maxilla, a portion of the floor of the antrum, and a portion of the sphenoid. In the efforts to remove the fractured portion with stump forceps the tooth and hamular process, with some fibres of the internal and external pterygoid muscles, were removed, the patient becoming perfectly deaf and the movements of the jaw restricted. Cases are also recorded of direct transverse fracture occurring during the extraction. Many of these cases are due to careless and clumsy operating, and many to the use of the key; but naturally, since the abandonment of this latter instrument this class of accident is not so common. Their treatment will depend upon the extent of injury. When necrosis supervenes after tooth extraction it should be treated by keeping the mouth scrupulously clean with antiseptic washes, allowing the sequestrum to be exfoliated.

(ii.) Dislocation of the lower jaw on one or both sides is not uncommon. It generally occurs under anæsthetics, and is due to employing too much force and not supporting the jaw by placing the fingers or thumb beneath it. The accident is easily recognized, and is of no serious consequence. To effect reduction it is necessary to protect the two thumbs with a napkin or folds of lint, to place them upon the back teeth, and depress the jaw at the posterior part; at the same time elevate the anterior part by placing the remaining fingers under the chin. This can usually be accomplished quite easily, still, should any resistance or trouble be met with, it can usually be overcome by placing the patient on as low a level as possible so as to allow the operator to use his force to the best possible advantage.

(iii.) *Forcing a tooth into the antrum.*—This accident happens with the second upper bicuspid more often than any other tooth. If a tooth is forced into the antrum, but still retained to a certain extent in the socket—partially dislocated—it should be left alone, as any attempt at removal might dislocate it completely—a far

¹ *Trans. Odontological Society*, vol. iii. p. 138.

more serious accident. If this latter condition does occur, the opening into the antrum must be enlarged and the cavity syringed with warm water. For this purpose an aural syringe, viz., one holding five or six ounces, should be used, as by this means a good stream can be obtained, the *rationale* of the treatment being that the tooth will be driven out with the return current. If this fails, a piece of curved wire with a piece of rubber attached may be used. Failing this, the antrum should be thoroughly syringed with some dilute solution and the tooth left alone, the chances being that it will become encysted and give rise to no trouble. The patient must be told of the presence of the tooth, as should trouble arise its nature would be apprehended.

(iv.) *Closure of the jaws* [Trismus] is a complication sometimes met with, and when due to reflex irritation from the wisdom tooth, or to abscess connected with the molars, may be overcome by placing the patient under an anæsthetic and forcibly opening the mouth with a Mason's gag.

(c) DIFFICULTIES AND COMPLICATIONS CONNECTED WITH THE
SOFT PARTS.

(i.) *Extensive laceration of the gum*.—This generally occurs in connection with the lower wisdom tooth, the gum around this tooth being very adherent; and, therefore, when in extracting this tooth the gum shows signs of adhering, it is better not to continue in the attempt to remove the tooth, but rather, after it has been loosened in the socket, to cut the gum away with a pair of curved scissors and so lessen the amount of laceration. No difficulty, as a rule, arises from this complication, still the mouth should be kept scrupulously clean with an antiseptic mouth-wash.

(ii.) *Wounding the tongue or floor of the mouth*.—When using the elevator, the gum, the floor of the mouth, and even the tonsil, may suffer injury from the instrument slipping. This accident is nearly always an avoidable one, if the precautions, mentioned when speaking of its use, are followed. The tongue may be

lacerated with the forceps, especially when it is hypertrophied, or when the patient is under the influence of an anæsthetic, during which time the control over the muscles is gone, the tongue is swollen, and the time for operating necessarily short.

The *treatment of the wounds of the tongue* is important. If there is much laceration, the overhanging portions must be removed with a pair of scissors, the wound being allowed to heal by first intention. If the wound is punctured and does not involve a large artery, it may be treated by inserting a stitch; and if the bleeding continues, the tongue should be drawn forward, as this assists in arresting the hæmorrhage by the fact that the vessels run parallel with the longitudinal muscular fibres of the tongue, and drawing it forward naturally brings pressure upon them. If the wound involves a branch of the lingual artery, the finger must be immediately placed over the dorsum of the tongue, and the organ drawn forward by the finger and thumb wrapped in a napkin; this compresses the lingual artery against the hyoid bone. An attempt may then be made to find the bleeding point, and, if successful, the vessel should be twisted. Failing this, it will be necessary, should the bleeding not cease, to tie the lingual artery.

(iii.) *Wound of the ranine*.—This accident may arise from the use of an elevator for the extraction of the lower front teeth. The treatment is to tie or twist the injured vessel.

(iv.) *Bruising of the lips* whilst extracting sometimes happens, and the swelling thus caused is often a source of great inconvenience to the patient.

(v.) *Injury to the inferior dental nerve* ["Mandibular nerve"] in extracting lower wisdom teeth is an accident which may occur. The injury may be simply bruising or actual laceration. In one case, related by Mr. Sewill, the nerve perforated one root of a lower wisdom tooth, and grooved the other. Anæsthesia of the lip, dribbling of saliva, etc., may follow according to the extent of the injury. The nerve, if torn, generally unites, sensation being restored.

(d) COMPLICATIONS AND DIFFICULTIES CONNECTED WITH
CERTAIN REFLEXES AND DIATHESES.

(i.) *Syncope*.—Of these, by far the commonest is syncope produced by the connection of the fifth cranial nerve with its numerous ganglia, and through them with the sympathetic system. A case of fatal syncope in connection with tooth extraction has been recorded.

(ii.) *Hysteria*.—In hysterical patients the pain or excitement of the operation sometimes produces manifestations of that disorder.

(iii.) *Tetanus*.—A case is reported by Dr. Döbbelin as having occurred directly after the extraction of a tooth. A case is also reported by Conrad, *Archives of Dentistry*, Nov., 1886.

(iv.) *Uterine pain*.—Mr. Sercomb quoted a case where extraction was followed by paroxysmal uterine pain, but which cured an obstinate leucorrhœa.

(v.) *Epileptiform convulsions*.—These frequently follow extraction in those predisposed to epilepsy. The treatment consists in placing the patient in the horizontal position, loosening the clothes about the neck, and placing something between the teeth to prevent them injuring the tongue.

(vi.) *Hæmophilia*.—This may be defined as an abnormal tendency to bleed. It generally occurs in males, though it is sometimes met with in females. Its pathology is doubtful, being supposed to be due either to some (1) abnormal condition of the vessel wall or (2) want of coagulability of the blood. The disease is always congenital, and is said to be inherited through the female parent.

(vii.) *Hæmorrhage*.—Hæmorrhage following tooth extraction is at times of very serious consequence. It is predisposed to by hæmophilia, and may be primary, recurrent, or secondary. Primary hæmorrhage is usually of little consequence. When more severe than usual, the use of quite cold water, or water as hot as can be borne, to which some hazeline or styptic has been added, will generally suffice to arrest it, plugging the socket rarely being found necessary.

Recurrent or reactionary hæmorrhage generally occurs as follows :—During the day the patient has had a tooth or teeth extracted, the bleeding has stopped, and all appears well ; in the night, however, he wakes up, finding his mouth full of blood and the bedclothes stained. Recurrent hæmorrhage is however more serious in character than primary hæmorrhage, and cases are recorded of fatal results.

When examining the mouth preparatory to endeavouring to arrest the hæmorrhage, the first point is to carefully diagnose whether the hæmorrhage is coming from the gum, the adjacent soft parts, or the bony socket. If the bleeding is coming from the gum, any little vessel may be twisted and pressure applied with a pad of gutta percha lined with lint dipped in some styptic. The *treatment* when the bleeding is from the socket consists in plugging, and should be performed as follows:—Prepare some cone-shaped pledgets of cotton-wool by rolling small pieces between the finger and thumb ; these should not be of too large dimensions. Also, cut a strip of lint about the breadth of the alveolus and of such a length that when folded into a pad it will stretch from the gum to the opposing teeth. A four-tailed bandage should also be prepared ; a syringe, some cold water, tannin, and a pair of conveying forceps will also be required. Everything being in readiness, proceed as follows:—Remove all blood clots from the mouth with pledgets of cotton held in conveying forceps ; after this the socket of the tooth should be syringed with ice-cold water, and then dried with a pledget of cotton-wool, and, directly this is removed, a cone-shaped piece of wool (already prepared) dipped in tannin should be placed into the socket and forced into place by using considerable pressure, fresh pieces being introduced, with an equal amount of pressure, until the socket is full. The number of pieces inserted should be counted. Each socket has to be treated in this way, and, when all are full to the level of the gum, the pad of lint should be placed in position, the opposing teeth closed on it, and the jaws bound together with a four-tailed bandage. The

pressure employed is the chief agent in arresting the bleeding, the styptic, whatever it is, being of secondary importance. Should teeth be present on either side of the socket, the pad of lint and four-tailed bandage can be replaced by a piece of wood, notched at either end, and forced down between the standing teeth. Another method, though not quite so effective, is to encircle the teeth with a silk ligature in the form of a figure eight, the crosses of the eight passing over the pad.

In addition to the plug in the socket, it will be as well to prescribe some hæmostatic remedy; what to use will depend upon the probable cause of the bleeding. If the blood, after leaving the socket, rapidly coagulates, the hæmorrhage is probably due to some want of contractile power of the coats of the artery; in such cases ergot should be used, as this drug causes contraction of unstriped muscle fibres; a hypodermic injection of ergotine can be given at the time.¹ The injection should be made deep in the muscles, and not just beneath the skin, and the following mixture taken every subsequent four hours until the bleeding ceases:—

R.	Extract. ergot. liq.,	-	-	-	-	℥xx.
	Acidi sulph. dil.,	-	-	-	-	℥x.
	Aq. ad	-	-	-	-	℥j.

Misce.

Should the blood, on emerging from the socket, show no signs of coagulation, then such drugs as gallic acid and perchloride of iron must be used. The former is most efficacious, and fifteen grains should be taken every two hours until the bleeding ceases. If the perchloride of iron is used, it may be administered as follows:—

R.	Liq. ferri perchlor.,	-	-	-	-	℥x.
	Aq. destill.,	-	-	-	-	℥j.
	Ft. M. To be taken every two hours.					

The general directions to give the patients are that they should keep as quiet as possible, and assume the sitting posture in a cool

¹Inj. ergotina hypodermica—Ergotine 1 part, camphor water 2 parts. Mixed by stirring together just before using. Dose, 3 to 10℥.

room. Hot fluids and stimulants are to be avoided, and nourishment taken in the form of some of the extracts of beef. If the patient shows signs of sinking, stimulants must be administered with care, and the body kept warm. In severe cases, transfusion may become necessary. The patient ought to be seen within the first twenty-four hours, and, if the bleeding has ceased, the plug may be removed or allowed to remain a little longer according to the discretion of the surgeon. When the hæmorrhage has been very severe or troublesome to arrest, it is better to allow the plugs to come away by themselves. If the bleeding has not ceased, then further methods must be employed. The socket may be replugged, and, if possible, firmer pressure than before employed, by inserting wooden wedges into the socket; or, still better, the extracted tooth, if available, with its roots wrapped in a little cotton-wool dipped in some styptic, may be used. If, in spite of all such methods, the bleeding still continues, the actual cautery may be used at a dull red heat; and if this fails, and the bleeding is from a socket in the lower jaw, the inferior dental canal should be exposed by a small trephine upon the dental engine, a plug of ivory inserted, so compressing the artery against the inner plate of the jaw. If this fails, or if the uncontrollable bleeding is in the upper jaw, then digital pressure upon the common carotid opposite the sixth cervical vertebra may be tried, and failing this, the artery itself must be ligatured, an operation of great gravity.

In one case recorded¹ of severe hæmorrhage, arising in connection with an alveolar abscess complicated by a fracture, Mr. Boyd excised the outer plate of the lower jaw and exposed the dental canal, both ends of which were plugged with catgut, and the hæmorrhage arrested. Patients having a tendency to bleed should be treated, for at least a week previous to the operation, with remedies similar to those recommended for administration in arresting bleeding. The tooth should be extracted early in the day, a subcutaneous injection of ergotine being given at the time, and the socket immediately plugged, as it is much easier to

¹ *Dental Record*, vol. xi. p. 433.

prevent the hæmorrhage coming on than to arrest it when it has occurred.

(viii.) *Pain following tooth extraction.*—Pain, occasionally of a severe character, occurs after the extraction of a tooth, especially if there has been much difficulty in effecting its removal. The principal causes giving rise to this condition are :—(1) Incomplete extraction of the tooth, especially if the piece still *in situ* contains an exposed nerve ; (2) too rapid healing of the orifice of the socket, causing the discharge from the granulations of the healing socket to be retained, and so leading to inflammation ; (3) extensive laceration of the hard and soft tissues ; (4) suppuration of the socket from septic infection through use of dirty forceps, or from general systemic conditions ; (5) from the presence of a foreign body in the socket, such as a cusp of the tooth, a piece of filling ; (6) many obscure cases probably arise from laceration or bruising of the nerve trunk or nerve endings.

Treatment.—In the first condition, the fragment of the tooth should be removed, or, if the pain is due to an exposed nerve some pure carbolic or nitric acid should be applied to the surface. In the second condition, a tent of cotton-wool or lint should be placed in the orifice of the socket for twenty-four hours, in order to keep it patent, an antiseptic mouth-wash being prescribed, such as liq. potass. and carbolic acid (see p. 335). In the third condition, an anodyne mouth-wash may be used, such as the following :—

R.	Zinci sulph.,	-	-	-	-	-	gr. viij.
	Zinci chlor.,	-	-	-	-	-	gr. vj.
	Morph. acetat.,	-	-	-	-	-	gr. ij.
	Aquam ad	-	-	-	-	-	ʒviij.

M. To be used as a mouth-wash.

In the fourth condition, the socket should be thoroughly cleansed by syringing with an antiseptic lotion, the healing of the part stimulated by allowing a small piece of chloride of zinc to dissolve in the cavity, and an antiseptic mouth-wash used. The fifth condition will probably not be diagnosed at the time, but injection of carbolic lotion (1 in 20) into the socket from a

large dental syringe will afford great relief in the sixth condition.

(ix.) *Septic and infective sequelæ.*—The various local and general septic and infective troubles which may follow upon wounds in general may also occur subsequent to tooth extraction. Dr. Miller has recorded thirteen cases belonging to this category, in all, with the exception of one, a fatal termination having resulted. Pyæmia, septicæmia, sapræmia may each occur, while meningoencephalitis, osteo-myelitis, meningitis, and cellulitis have been recorded. The symptoms, diagnosis, and treatment of these belong to general surgery.

(e) ACCIDENTS UNDER ANÆSTHETICS.

(i.) Tongue slipping back over the larynx.—During extraction under anæsthetics the tongue, not being under control by the patient, may slip back, or may become pushed back by the fingers of the left hand of the operator. The symptoms will be arrest or difficulty in breathing, followed, if not attended to, by asphyxia. The treatment consists in removing the fingers from the mouth and, if necessary, pulling the tongue forward and forcibly extending the head on the spinal column.

(ii.) *Forcing out a tooth with the prop.*—Occasionally a tooth, more especially a front one, may be forced out by the prop. Should such an accident arise, the tooth must be immediately replaced.

(iii.) *Passage of a foreign body through the isthmus of the fauces.*—The foreign body which may pass into the throat may be either (1) a tooth, (2) a piece of fractured forceps, (3) a piece of broken gag. The foreign body may become (1) arrested over the entrance of the larynx, (2) lodged in the larynx, (3) lodged in the trachea or bronchus (usually the right), (4) impacted in the pharynx, (5) impacted in the œsophagus, (6) arrested at the pyloric opening of the stomach.

In the first two instances, the patient will be seized with a violent fit of coughing, and all the symptoms of impending suffocation. The treatment consists in bending the head well

forward, inserting the finger along the side of the mouth into the pharynx, and then giving it a sweeping movement forward; this will clear any foreign body situated over the back of the tongue, or in the mouth. If this treatment fails, inversion should be tried, a good slap on the back being given at the same time; in this case all preparations must be made for the instant performance of laryngotomy, as if the foreign body impinges upon the inner aspect of the larynx spasm will be excited.

In the third condition, namely, when the body passes straight into the trachea or bronchus, the symptoms will vary. At the time of the accident none may be present, or they may be urgent, that is: the patient is seized with a violent fit of coughing, and symptoms of impending asphyxia supervene; the symptoms may be relieved for a time but subsequently give rise to paroxysmal attacks of coughing and dyspnoea, and eventually to collapse of the lung. In the case recorded by Sir William MacCormac, there was great dyspnoea at the time of the accident; but this, with other symptoms, gradually passed away, the patient during the subsequent five or six weeks suffering from pain on the right of the sternum, and constant spasmodic cough with bloody expectoration.

The *diagnosis* of the presence of a foreign body in the bronchus may be ascertained by the absence of breathing sounds over the affected lung, or part of the lung, and puerile breathing over the opposite one. The treatment, if the position of the foreign body can be accurately defined, consists in performing tracheotomy and removing the body with suitable forceps. When the impaction takes place in the pharynx, symptoms of dyspnoea or dysphagia are said to be present. The foreign body should be removed with the fingers or pharyngeal forceps.

Impaction of the foreign body in the œsophagus or pyloric opening of the stomach may give rise, in the former, to symptoms of dysphagia, and, in the latter, to gastric dilatation. The patient should be advised to take porridge, new bread, etc. The further treatment belongs to the domain of general surgery. It must not be forgotten that when a foreign body passes through

the isthmus of the fauces it will, as a rule, pass into the œsophagus, and so into the stomach. Still further, that a tooth will not be likely to become impacted in any part of the alimentary tract. In operating under anæsthetics, should a tooth slip from the forceps, the head must be immediately bent forward, and no fresh tooth extracted until the previous one is removed from the mouth. In all teeth liable to shoot between the blades of the forceps, it is as well to keep a finger of the left hand behind the instrument, as this may direct the tooth outwards should it slip between the blades.

CHAPTER XVI.

ODONTALGIA AND NEURALGIA.

THE terms odontalgia and neuralgia, used in a dental sense, have led to some confusion as to their exact meaning; it will therefore be well, at the outset, to explain the difference between them.

Odontalgia is the name used to indicate pain in or around a tooth or teeth. This may be due to local trouble in the tooth, or may be referred to it as the result of irritation in another tooth, or in some distant part of the body.

Neuralgia, on the other hand, means pain in the course of a nerve, or in the area of its distribution; when, therefore, occurring in the course of the fifth nerve, it is generally termed trigeminal or trifacial neuralgia; this is induced by many causes, foremost amongst them being dental irritation. The reason why, on the one hand, irritation of a distant tooth or viscus gives rise to odontalgia, and, on the other, dental irritation causes neuralgia and other secondary affections, is not, in all cases, quite clear, still an explanation seems possible in some instances. It must be remembered that irritation of a nerve in any part of its course may set up pain in any other part of that nerve or its connections. The recent researches of Gaskell confirm the fact of the intimate connection between the fifth pair of nerves with both the glosso-pharyngeal and vagus; this latter being connected with the viscera of the abdomen and pelvis.

Odontalgia may be classified under two headings, viz., (1)

local, (2) referred. By local odontalgia is meant, pain in or around teeth which are themselves the cause of the trouble ; by referred odontalgia is connoted, pain in a tooth which is not itself the seat of the cause.

(1) **Local odontalgia.**—Nearly all morbid conditions of the teeth may be cited as causes of local odontalgia, and for convenience can be grouped under (1) morbid conditions of the tooth pulp ; (2) morbid conditions of the alveolar periosteum. The principal affections under the first head are irritation, acute and chronic inflammation, and under the second, acute and chronic periodontitis and its terminations. Local odontalgia may be acute or chronic, and for practical purposes the source may be considered to be either pulp or periosteal.

Acute local odontalgia is generally due to either acute inflammation of the pulp or periodontal membrane. If due to inflammation of the pulp, the pain will be of a sharp, shooting, throbbing character, more severe when the patient assumes the horizontal position, and greater at night than in the morning. Paroxysms of pain will also be caused by alterations of temperature. A small pledget of cotton-wool placed in the cavity, and gently pressed upon with a blunt instrument, will generally produce pain, as this form of odontalgia is generally due to exposure of the pulp. In a few cases the application of cold brings relief, while heat intensifies the pain ; a condition of this character points to congestion of the pulp, the cold constricting the arteries and so reducing the blood pressure, the heat dilating the vessels and therefore increasing it.

If periosteal inflammation is the cause of the odontalgia the pain will be found to be of a dull, gnawing, constant character. Percussion of the tooth with an instrument will generally produce pain (not as a rule present in pulp pain). Pressure with the finger upon the crown of the tooth will also produce pain, while tenderness of the alveolus is usually present. A pledget of cotton-wool introduced into the cavity, if one exists, will not give rise to any pain except that which is caused by the pressure transmitted to the periosteum.

The *treatment* of acute local odontalgia depends upon the cause, and the remedy for each morbid condition has already been dealt with in previous chapters. Temporary relief of the pain in cases of pulp trouble may be obtained by applying to the cavity, on a piece of cotton-wool, some sedative, such as oil of cloves, cinnamon, peppermint, or carbolic acid, covering over the drug used with some loose dressing, such as cotton-wool dipped in gum sandarac or mastich. Periosteal pain can generally be relieved by scarification, leeches, or a strong application of liniment of iodine, to which some tincture of aconite may be added. When the pain is due to tension in the pulp cavity from a putrescent pulp, relief can be obtained by opening the pulp chamber and so giving exit to its contents.

Chronic local odontalgia.—The causes of this, like those of the acute form, may be either pulp or periosteal, and under the former group chronic inflammation and hyperæmia are common causes, while under the latter is chronic periostitis, especially that form which terminates in organisation (exostosis). The symptoms arising from the pulp will be pain at irregular intervals, the character being not so intense as in the acute variety, while there is a tendency for it to wander and become neuralgic, that is, follow the course of the nerve. Alterations of temperature generally produce a paroxysm of pain, which may pass away at once or continue for some time. When the cause of the odontalgia is from the periosteum the patient will complain of a grumbling sensation in the tooth, with tenderness on pressure. The gum over the alveolus will be swollen, congested, and tender, the pain will usually be constant and not paroxysmal, as is the case when arising from pulp trouble.

The treatment, as in the acute form, depends upon the cause and the remedy, for each has been dealt with in previous chapters.

(2) **Referred odontalgia.**—Referred odontalgia may arise from many causes, and these can be classified as follows:—

- (a) Peripheral.
- (b) Central or cerebral.
- (c) Systemic or general.

(a) *Peripheral*.—Any conditions which may give rise to irritation of the terminal portions of the fifth nerve and its connections may cause reflex odontalgia, and by far the commonest under this heading is that which is dental in origin, namely, where the cause is another tooth which itself is not the seat of pain. Such cases are of constant occurrence; a patient perhaps complains of pain in a lower molar which, on examination, is found to be free from disease, the cause eventually being discovered in perhaps an upper tooth. This condition, generally called *referred toothache*, is often so well marked that manipulation of the offending member will cause paroxysms of pain in the sound one, and in one case well within the authors' recollection, the application of arsenic to the diseased tooth caused pain in the sound tooth during the process of devitalisation. Pain may be referred from an upper to a lower tooth, or the converse; it may also be referred from a tooth on the same side of the same jaw. Perhaps the commonest and most instructive example of referred pain is that of a lower wisdom tooth causing symptoms in a lower bicuspid. Pain is never referred across the median line of the mouth. Morbid conditions of the periosteum of the jaws, and ulcerations of the mucous membrane, etc., may act as causes of odontalgia, and likewise operations upon or morbid conditions of the eye and nose. Cases supporting this latter statement are quoted by Galezowski¹ and Macnaughton Jones.²

The last group of conditions to be recorded under this heading are those arising from distant viscera. It is a well-recognised fact by most gynæcological practitioners that morbid conditions of the pregnant or non-pregnant uterus may cause odontalgia. In addition to uterine troubles, cases of disorders of the alimentary tract, passage of biliary and renal calculi, are recorded as leading to distinct odontalgia.

(b) *Cerebral or central origin*.—A few cases of odontalgia, pointing to a cerebral origin, have been recorded; and in one case under the care of Dr. Benson (*British Journal of Dental Science*, August, 1867), pain in a first upper right molar was apparently

¹ *Journal d'Ophthalmologie*, tome i. p. 606. ² *Lancet*, 1889, vol. i. p. 359.

due to a cerebral abscess. Hysteria seems undoubtedly to be a cause of odontalgia, or, in other words, odontalgia may be a manifestation of hysteria. A case of this character is reported by one of the authors in the *British Medical Journal*, 1880, vol. i. p. 362. The patient complained of pain in a first lower molar, containing a carious cavity. This was dressed, but the tenderness of the tooth and pain continued despite all treatment. Suspicion as to hysteria was aroused; and on pretending to tap an upper tooth with an instrument, the one complained of was touched with no resulting pain, this experiment being performed several times with the same result.

(c) *Systemic, or general origin.*—Malaria, gout, rheumatism, and syphilis may cause odontalgia, but in the majority of cases they act simply as predisposing causes. People inhabiting malarial districts are certainly liable to distinct periodic attacks of odontalgia, which are only relieved by quinine and such like remedies.

The diagnosis of referred odontalgia is not always possible at the time. If, after examining a tooth or teeth to which the pain is referred by the patient, no local cause can be found for it, then a systematic examination must be carried out. As this is practically similar to the method to be pursued for investigating cases of neuralgia, it will be considered under that heading.

Neuralgia.—Neuralgia means pain in the course of a nerve or the area of its distribution. When occurring in connection with the fifth nerve, it is known as trigeminal or trifacial neuralgia. In some instances, neuralgia seems to be hereditary; it is also predisposed to by the neurotic temperament, overwork, and fatigue, which probably act by producing lowered vitality on living in cold damp atmospheres.

The exciting causes may be—

- (1) *Peripheral*, due to irritation of the terminal parts of the fifth nerve or any of its terminations. Under this heading are included—(a) *Morbid conditions of the pulp*, such as chronic inflammation and degeneration; (b) *Morbid conditions of the alveolar periosteum*, such as inflammation and its termination, especially when ending

by the formation of exostosis ; (c) *Morbid conditions of the gums and mucous membrane of the mouth, nose, etc.* ; (d) *Morbid conditions of remote parts, such as the uterus.*

- (2) *Causes affecting the nerve in its passage from the brain to its terminations, including—(a) Injuries from contusion and laceration ; (b) Pressure from impaction of lower wisdom teeth, periostitis of the bony canals, and presence of tumours ; (c) Implication of the nerve in syphilitic gummata, carcinomatous and other tumours, and inflammations.*
- (3) *Cerebral or central causes, such as sclerosis and other degenerative affections of the nervous centres.*
- (4) *Constitutional.—Malaria, anæmia, and hysteria.*
- (5) *Many cases are apparently idiopathic.*

Symptoms.—The characteristic symptom of neuralgia is pain of a boring, shooting, or burning character. It is nearly always paroxysmal in form. Palpation over the affected area will reveal tender spots, these being generally at the exit of the nerve from a bony foramen. In severe cases the pain becomes so intense as to make the patient's life unbearable, the paroxysms being started by touching the affected parts, washing even being avoided. Even slamming of a door, a sudden noise, or a draught of air may initiate an attack. In one variety of facial neuralgia, which has been termed "tic epileptiforme," the paroxysmal attack is similar to that of an epileptic seizure. The disease may attack the first, second, or third division of the fifth nerve separately or simultaneously.

The diagnosis of the cause of facial neuralgia is important on account of the treatment, and all cases coming under notice should be subjected to a systematic examination.

The patient should be questioned as to the character of the pain to discover whether it arises from the pulp or periosteum. It is also important to ascertain whether it is periodic ; while, at the same time, the situation of the pain is important in assisting to localise the position of the tooth should the neuralgia be due to one. Thus, pain in the infra-orbital or supra-orbital

region points to upper teeth; pain in the ear, shooting down the shoulder, points to lower teeth; while pain over the parietal eminence, to trouble from either upper or lower teeth. Next, the teeth must be examined for carious cavities, and should any be found, a search should be instituted to discover if any chronically-inflamed pulps exist. This examination should be carried out with a mirror and probe, care being taken to discover the presence of approximal cavities near the gum margin. After this, periosteal causes should be excluded by pressing and tapping each tooth. Irritability of the pulp through pathological changes must next be eliminated by testing with heat and cold, and in doing this, attention bestowed upon teeth containing large metal fillings. In testing with heat, a steel burnisher should be made nearly red hot, and applied to each tooth separately; while the test with cold is easily carried out by touching each tooth with a small pledget of cotton-wool dipped in ice-cold water. If a jet of cold water is used from a syringe, the water will run over two or three teeth at a time, and so prevent exact detection of the tooth. It must not be forgotten that most teeth with live nerves, if submitted to the above treatment, will respond to the changes; but when the pulps are healthy, the condition will be quite transient, while, if diseased, the test will probably set up an acute paroxysm of pain.

If a cause has not been discovered by the above mentioned examination, the absence of wisdom teeth, a frequent cause of neuralgia in those between 18 to 30 should be investigated. Such causes as morbid conditions of the periosteum of the bony canals through which the nerve passes, peripheral irritation in other parts of the distribution of the fifth nerve, and pregnancy, must next be excluded. Failing these, the presence of antral mischief or tumours in the region of the trunks of the nerve should be looked for, and then the question as to degenerations of the nerves themselves or their origins in the brain considered.

The treatment.—If the neuralgia is due to any dental cause it must be removed by measures indicated for the treatment of such

lesions. When the cause can be traced to some constitutional condition, this must be dealt with by appropriate remedies. For instance, if arising from general debility, anæmia, or overwork, a general tonic treatment with such drugs as iron, quinine, and arsenic will prove useful, careful attention being paid to the condition of the bowels. If of malarial origin, quinine in large doses, such as gr. v., will be found to bring immediate relief, and if given before an attack will in some cases ward it off, while in others it will greatly minimise its severity. Should there be any suspicion of syphilis, iodide of potassium will be indicated; while with gout and rheumatism the same drug may prove useful. In addition to the internal administration of drugs, local applications may be tried, such as chloral and camphor, equal parts, aconite and chloroform, or counter-irritants, such as cantharides, capsicum, and mustard. In more severe cases, electricity, the injection of cocaine, or morphia, may be resorted to. If no cause can be found, and the above treatments fail, drugs which may be termed "neuralgic specifics" should be tried, amongst these being Tinct. Gelsemini (8-15℥), Veratrina ($\frac{1}{70}$ - $\frac{1}{16}$ gr.), Butyl chloral hydras (2-15 gr.), tonga. In combination with these, such drugs as dilute hydrobromic acid, chloral, and bromide of potassium may be combined.

In cases where treatment by drugs proves futile, the patient continuing in great pain, so that life becomes unbearable, surgical measures may be adopted. These include stretching of the affected nerve, division of the nerve (neurotomy), resection of a portion of the nerve (neurectomy), or removal of either Meckel's or the Gasserian ganglion. When the pain is limited to the inferior dental or distribution of the inferior orbital nerve, resection may prove useful; if it involves the whole distribution of the second division, then removal of Meckel's ganglion may be attempted; while in those dreadful cases involving the whole of the distribution of the fifth nerve, the removal of the Gasserian ganglion might be attempted. But these questions belong to the domain of general rather than dental surgery.

CHAPTER XVII.

FRACTURES OF THE JAWS.

IN dealing with this subject it will be convenient to consider it under two heads:—(1) Fractures of the lower jaw; (2) Fractures of the upper jaw.

(1) **Fractures of the lower jaw.**—Probably from its exposed position, fractures of this jaw are more common than those of the maxilla.

The principal *causes* are kicks from horses, blows from the fist, falls (especially on the chin), and gunshot injuries. Such rare causes as fits of coughing are recorded in Gross's *Surgery*, p. 964. It may be caused by undue violence during extraction, though direct transverse fracture arising in this way is rare; but fracture of the alveolus, though commonly occurring, is of little importance, nothing more serious than the exfoliation of the portion so fractured taking place. The fracture is generally single, but occasionally is double, triple, or comminuted, the latter generally occurring in gunshot wounds and severe accidents, such as the passage of a heavy vehicle over the jaw. From a surgical point of view, the fracture may be simple or compound—simple in the case of the ascending ramus, compound in that of the horizontal. The *position* of the fracture depends partly upon the situation in which the blow is received, and partly upon any predisposing cause that may be present, such as the loss of teeth at certain points. Fractures of the horizontal ramus are far more common than those of the

ascending, Hamilton recording 40 out of 43 cases. When occurring in the former region the neighbourhood of the canine is by far the most frequent situation, principally owing to the fact that the depth of the canine socket considerably weakens the bone at this spot. The region of the mental foramen and symphysis are other common situations, and, next to these, perhaps the most usual is the region of the last molar. Statistics, however, seldom entirely agree on these points.

The *direction of the line of fracture* is usually oblique, though when occurring at the symphysis it may be quite vertical. It may be horizontal, involving the alveolus of several teeth, and a severe case of this character is mentioned by Tomes,¹ in which a fracture running level with the apices of the teeth and carrying the bicuspid, canine, and incisors, had occurred in an attempt by a chemist to extract a first lower molar on the right side. Fractures of the ascending ramus may occur in nearly any situation, and are generally the result of great violence, the angle and condyloid process being frequent seats of the injury; more rarely the apex of the coronoid process is fractured.

The *symptoms* of fractured jaw are generally well marked when occurring in the horizontal ramus; in the ascending, on the other hand, they are often obscure. In both the patient usually complains of pain on opening the mouth. While in the former there will be distinct crepitus, mobility in the continuity of the part, and frequently alteration in the line of the teeth due to displacement. In addition to this, there is very often more or less salivation, and, in some cases where the displacement is great, an inability to close the mouth.

The *displacement* which occurs may vary according to the character and situation of the fracture. When the fracture is single, and occurring, for instance, through the canine region, the lesser fragment generally overlaps the greater, the temporal muscle, and still more the masseter, causing it to be drawn in an outward and slightly forward direction. In addition to the action of the muscles, the obliquity of the fracture also assists

¹ *Dental Surgery*, 3rd ed. p. 623.

in bringing about the displacement. In double fractures through the canine regions the small or median fragment is generally displaced downwards and backwards by the depressors of the lower jaw. In those far back in the region of the last molar the smaller or posterior fragment is drawn upwards and inwards towards the median line, probably by the action of the pterygoids and temporal muscles. This displacement was extremely well marked in a case recorded in the *Transactions of the Odontological Society*, January, 1892.

Fractures of the ascending ramus are generally accompanied by much swelling, but present little displacement. Pain is, as a rule, referred to the fractured part, and, by passing the finger of one hand well back in the fauces and applying the other outside, crepitus may generally be obtained. In severe cases the upper fragment may be tilted forwards by the action of the temporal muscle. In fracture about the angle of the jaw the pain is often referred to the wisdom tooth or mental foramen, and when the soft parts are much swollen the fracture may, unless care be taken, be altogether overlooked. Fractures of the condyle are generally accompanied by some pain and a difficulty in moving the affected side, while crepitus may be apparent to the patient. The condyle may be drawn forwards on the eminentia articularis by the external pterygoid muscle, and this displacement can be felt by the finger inside the mouth. In these cases the chin is turned a little towards the affected side, not from it, as in the case of unilateral dislocation of the articulation—an important point in the differential diagnosis.

Complications occasionally arise, such as severe wounds of the face, especially the lips, hæmorrhage from laceration of the soft parts, or even tearing of an artery. In one case a traumatic aneurism formed, which necessitated ligature of the common carotid. Dislocation and fracture of the teeth may occur, and paralysis and neuralgia may follow, arising from injury to the inferior dental nerve, or implication of it in the mandibular or callus. Dislocation or even injury to the base of the skull are recorded complications. More or less necrosis of the ends of the

fragments, leading to abscess, may also occur, and lastly, salivary fistula may supervene.

Fractured jaws as a rule do very well under treatment, generally requiring a splint to retain the fragments in position for about six weeks. Occasionally union is delayed, or does not take place. The causes leading to this result are practically the same as those giving rise to un-united fractures in other parts of the body. Of these the principal one in the lower jaw is probably necrosis (which produces at times a considerable space between the fractured ends), unusual difficulty in treatment, slipping of a tooth or some foreign body between the fragments, and want of rest due to a badly-adapted splint.

In *un-united fractures* one of two things generally happens, either a "false joint" is formed by a development of fibrous tissue or "fibrous union" takes place between the fractured ends.

For *treatment* various methods are adopted, the simplest being a four-tailed bandage, and to this a splint of gutta percha forms a valuable adjunct. The splint should be lined with chamois leather, and have several holes made in it to allow of evaporation. The parts should be also sprinkled over with some dusting powder, as this assists in preventing decomposition.

The gutta-percha splint and bandage are useful as temporary measures, and may be used permanently with advantage where there is no displacement; but an interdental splint is always to be preferred. The objections to the bandage and its adjuncts are these:—(1) To apply them, it is necessary to bind the lower jaw tightly against the upper, and accordingly prevent mastication, etc.; (2) when there is any tendency to displacement they do not overcome it; (3) in oblique fractures they cause the fragments to overlap by the pressure applied from without.

Of interdental splints there are three patterns which deserve attention, viz.: the Hammond or wire splint, the Hayward or Kingsley class, and the Gunning, each being useful in its proper place. To make an interdental splint the first step is to obtain impressions of the lower and upper jaws. This is not always a simple operation, and at times it is necessary to take the impres-

sion of the lower jaw in half trays, providing the upper jaw affords a sufficient guide to the articulation. Wax is the best material to use for these impressions, as it requires little heat to soften it and is easily removed from the mouth. If wax is not to hand composition may be substituted; it is advisable not to allow this material to become hard before removing it from the mouth. When the models have been cast, the lower one should be divided at the line of fracture, and the fragments pieced together so that the bite can be carefully adjusted to the upper. By this means the original contour of the lower model is obtained, and the fragments united in their new positions; to the corrected model so obtained the required splint can be made.

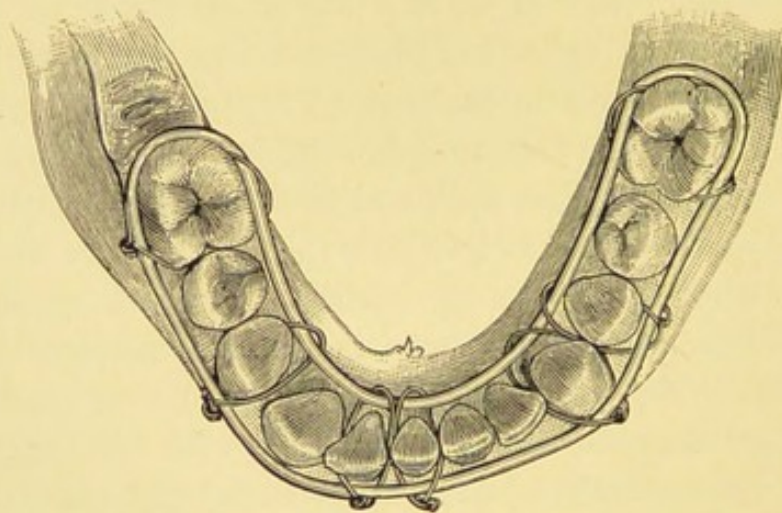


FIG. 329. Hammond Splint *in situ*. The fracture is supposed to be between the central and lateral incisors upon the right side of the figure.

The Hammond, or interdental wire splint (fig. 329), is an excellent contrivance in suitable cases. It is made by bending soft iron wire and adapting it as accurately as possible to the model, the wire running on the lingual and labial sides of the teeth, the ends being joined by soft solder. Some prefer to fit the wire to the mouth, but, unless great haste is necessary, this seems a needless proceeding.

When the splint has been prepared the fragments are brought into position, and the splint placed over them, the teeth being

fixed to the splint by means of ordinary iron binding wire. The method of passing the wire is as follows:—The end of the piece to be passed should be given a slight upward curve, inserted from without over the top of the outer bar, a downward direction being maintained, in order that it may be passed under the inner bar; with the forefinger of the left hand the point must be felt for and the wire returned over the inner bar and brought out under the outer one, and the two ends twisted together and bent down under the bar. The reason for passing the wire over the bar at the outset is, that if it be passed under the outside bar, in returning, the wire will have to be passed under the inner bar, which is by no means as easy as returning it over the bar (fig. 329). By giving the wire a slight upward curvature as suggested, it not only makes it easier to pass, but also lessens the risk of pricking the side of the tongue. Mr. Newland-Pedley, in order to overcome the chance of traumatic inoculation from pricking of the finger by the wire, has devised two pairs of forceps, with suitable curvatures, and also a spoon-shaped spatula, this latter assisting in protecting the mucous membrane of the mouth, in reflecting light, and directing the tip of the wire upwards. Before applying the splint, it should always be seen that the teeth are free from tartar. When there are plenty of teeth standing, those adjacent to the fracture should not be wired, as it only aggravates any inflammation that may be present. It is not needful to wire each tooth; every other one is generally sufficient. After applying the splint, it is well to see the patient within a week, as the wires generally require slightly tightening. An antiseptic mouth-wash should be prescribed, and the patient directed to rinse the mouth frequently.

A modification of this splint is much used at Guy's Hospital, and is extremely useful where the lesion is anterior and the displacement is not great. To quote Mr. Newland-Pedley's words,¹ "The main strand is not passed behind the last tooth, but between two teeth on each side of the jaw in the following

¹ *Trans. Odontological Society*, vol. xvii. new series, p. 16.

manner:—The point of the wire is sharpened by being divided obliquely with cutting pliers, and passed into the cavity of the mouth between the bicuspid or the more posterior, and is brought out again by being pressed from the lingual surface between two teeth on the opposite side of the jaw. The intervening portion now lying on the tongue is manipulated into close contact with the lingual surface of the necks of the teeth. The wire is then carried across the labial surface of the teeth, and its ends twisted loosely together. It is not desirable to twist up the main strand very tightly at first, for so doing would impede the passage of the binding wires, and tend to drag away the strand from the lingual surface of the teeth. The binding wires are passed in the usual way, and twisted together loosely at first. Finally, all the wires are twisted tight, a few turns being given to first one and then another; the ends are cut short and tucked under the splint to avoid excoriation of the mucous membrane. Rarely should a binding wire be attached to a tooth immediately contiguous to the line of fracture." A rather useful way of fastening the ends of the main strand is to pass the main wire through a piece of closely-fitting metal tube and give the ends a turn in the opposite direction.

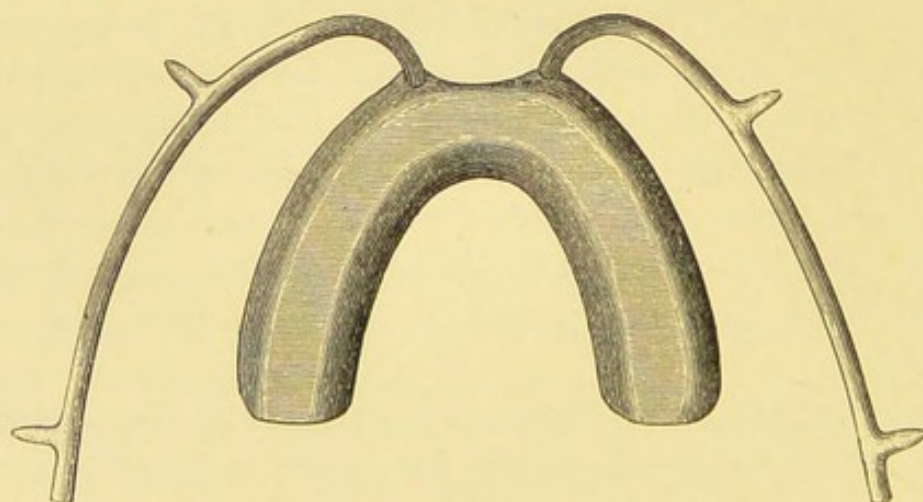


FIG. 330.

The *Hayward splint* (fig. 330), sometimes known as a *Kingsley*, consists of a vulcanite cap fitting the teeth, into the sides of which

iron wires are fixed in such a way that, when in position, the wires lie outside the mouth. This wire should be about one-eighth of an inch in thickness, should curve well up as it emerges from the mouth to avoid rubbing the lips, and should terminate at the angles of the jaw. It is well to solder on two points, one towards the front and another towards the back of the wire, the front one preventing the bandage slipping forward (a constant trouble), while the back one is also useful for fixing the bandage when pressure about the angle is required. These splints are generally made loosely fitting, and then filled with some form of gutta percha. This ensures a perfect fit, and is especially useful in cases of children, where the teeth are generally thin and sharp, or where it is not quite certain of getting the fragments back into perfect apposition. When ready for insertion the gutta percha should be thoroughly softened, the displacement reduced as much as possible, and the splint forced into position. A compress of

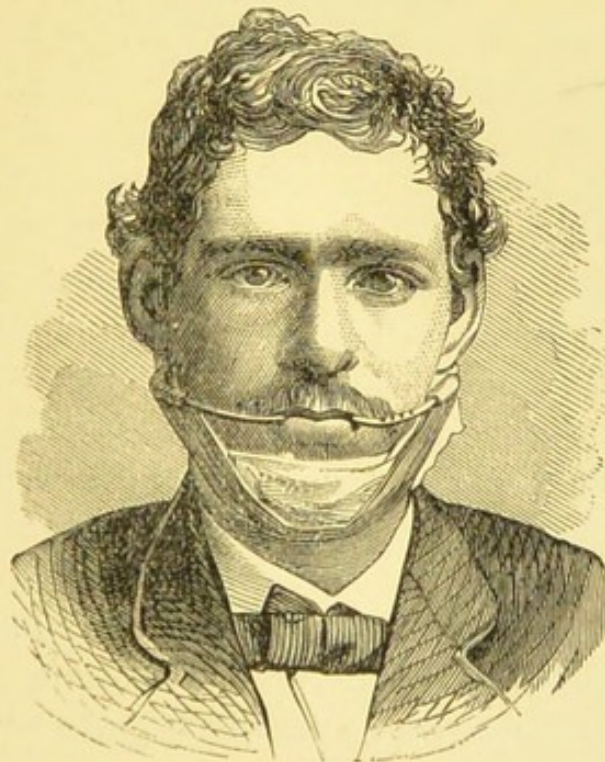


FIG. 331.

some kind is then placed under the chin, and the whole fixed with an inch bandage (fig. 331). In bandaging, care must be

taken to see that it does not slip too much forward. With children, especially if the operation is likely to prove at all painful, it is as well to administer an anæsthetic. The jaw in this class of splint is fixed between the vulcanite cap inside and the bandage outside the mouth.

The *Gunning splint* consists of vulcanite caps joined together by supports, and constructed to fit both the upper and the lower jaws. These caps can be filled with gutta percha described above (fig. 332). When the splint is in position a four-tailed

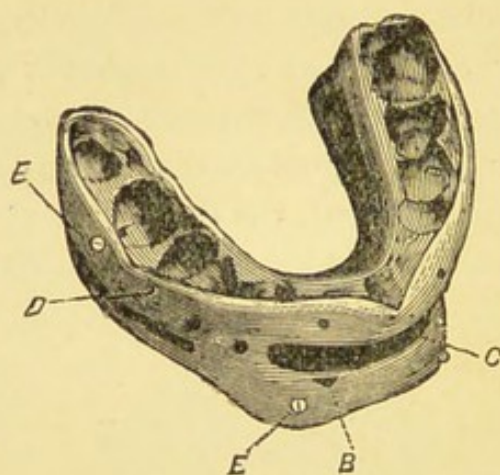


FIG. 332.

bandage is applied, and the jaws are, therefore, practically fixed into the splint by the outside bandage.

The *Hern splint*, a modification of the Gunning splint, consists of a vulcanite cap covering the teeth and alveolar border of the lower jaw, blocks or pillars being built up in the upper surface of the splint, these pillars containing indentations corresponding with the upper teeth (fig. 333). In cases where the occlusion and articulation is difficult to obtain or doubtful when obtained, the pillars or blocks are built up of vulcanite so as to form shallows, troughs, or cavities into which gutta percha is placed for articulation with the upper jaw.

This splint is applied in a similar manner to the Gunning, but instead of a four-tailed bandage, Mr. Hern prefers a skull and a chin cap, the connecting bands between the two being arranged

in a similar manner to the tails of the "four-tailed bandage." The bands are made of elastic, as by this means a constant pressure is obtained and the tendency of the fragments to downward displacement prevented.

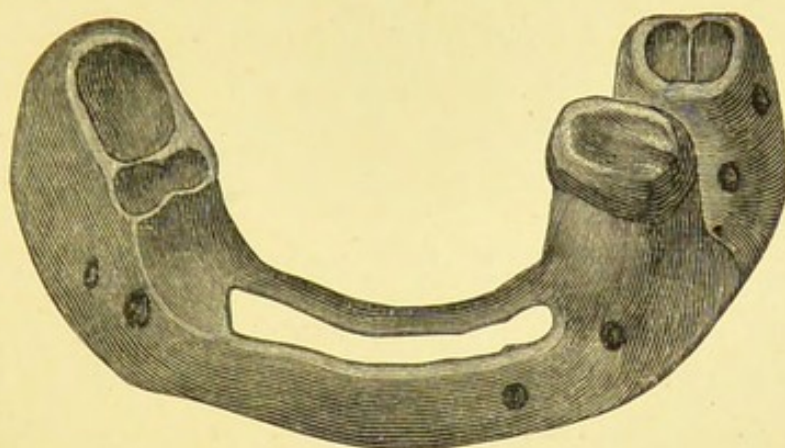


FIG. 333.

The advantages of this modification of the Gunning splint are—(1) The upper teeth are not covered, and so can be kept clean ; (2) it can be adjusted and removed with greater facility ; (3) it is much less cumbersome ; (4) it allows of the adjustment of the articulate to the upper jaw after it has been applied, by cutting and articulating the vulcanite surface with the dental engine or by adding to or removing from the gutta percha in the troughs.

The choice of a splint will depend to a great extent upon the requirement of each individual case. For a fracture occurring in a mouth containing firm teeth, so that each fragment contains a few, a Hammond's splint is undoubtedly best. Its advantages are the small amount of inconvenience to the patient in the way of mechanical contrivances, the perfect rigidity which can be obtained between the fragments, the non-interference with speech and mastication, and the ease with which the parts can be kept clean and therefore the small risk of necrosis. Its use is contra-indicated first when there is much downward displacement, especially if the teeth are very short, or loose, and secondly in children, unless the temporary teeth are healthy and firm. In

these latter cases a Hayward splint may be used with advantage, and also where there are but few teeth standing, or the smaller fragment only contains one or two teeth. This splint is very successful in keeping the fragments at rest, but has the disadvantage of interfering with the patient when attempting to lie on the side. Many discard it for this reason and use a Gunning, but the advantages are, we think, more than counterbalanced by the fact that in the case of the Hayward splint the jaw is movable, and therefore speech and mastication can be carried on.

The most suitable cases for a Hern's splint are (1) those where there are no firm teeth in any fragment; (2) edentulous cases; (3) where the fracture is behind the wisdom or last standing tooth, or in the ramus of the jaw. The Gunning splint is indicated where both upper and lower jaws are fractured.

Among the disadvantages of these splints may be mentioned:— (1) The closure of the mouth, leading to suspension of speech and mastication; (2) the dribbling away of saliva; (3) the great fatigue from propping open the jaws; and (4) the difficulty of keeping the splint and mouth clean.

In the *treatment* of horizontal fractures involving the alveolus of two or three teeth, a cap of gutta percha or vulcanite is quite sufficient, or the fragment may be wired to adjacent teeth. In more severe cases a Hammond splint (or a modification of it) is perhaps the best.

In *fractures about the angle* an outside gutta percha splint should be made in such a way that it passes back and catches the angle. The splint can be kept in position with a four-tailed bandage; but, whatever method of bandaging is used, endeavour must be made to get firm pressure over the part of the splint covering the angle, as this will assist in keeping the parts at rest by preventing the splint shifting. It is generally found that after a period of about a week it is necessary to remodel the splint. Almost invariably there is considerable swelling about the parts, and as this subsides the splint naturally requires remodelling.

Fractures of the ascending ramus, condyle, or coronoid process

are best treated by simply keeping the jaw fixed by means of a four-tailed bandage.

(2) **Fractures of the upper jaw.**—Fractures of the upper jaw generally arise from severe violence, such as kicks from animals, gunshot wounds, etc. They are frequently comminuted, adjacent bones, such as the malar and nasal, being often at the same time implicated. Transverse fractures involving the entire separation of the alveolar process from the body of the bone have been recorded, the fracture sometimes communicating with both antra and the nasal fossæ. In a recent case under the care of Messrs. Ackery and Paterson,¹ the fracture (caused by a severe blow on the left side of the face) commenced to the left of the infra-orbital plate, and, passing downwards, ended on the opposite side, about half an inch above the alveolar border. The whole upper jaw could be moved *en masse* in a downward direction, and also laterally to the right as if “hinged” above the alveolar border on the right side.

Separation of the two maxillæ in the median line has also been recorded. Lastly, fracture of portions of the alveolus, and at times of the tuberosity, occasionally occur during the extraction of teeth. The complications encountered are to a great extent similar to those in the lower jaw, but the hæmorrhage is generally more severe, and at times the infra-orbital nerve becomes permanently injured.

The *treatment* of fractured upper jaw does not differ in principle from that of the lower. Teeth, unless very loose, should be retained, and the same course should be pursued with fragments of bone, since the parts are so vascular that there is every chance of good repair taking place. In cases involving the alveolar plate of several teeth a Hammond splint is quite applicable. The Hayward and its modification are of little use, but the Gunning is useful, and especially so where both jaws are implicated.

Dislocation of the jaw.—Dislocation of the jaw may be unilateral or bilateral, the latter being more common. The cause of this

¹ *Trans. Odontological Society*, vol. xxii. new series, p. 65.

accident may be violence, such as blows or kicks; it may arise through yawning, vomiting, shouting, the endeavour to introduce large substances into the mouth, or during the extraction of lower teeth through the jaw not being supported during the operation. The unilateral variety is generally due to violence. In dislocation the condyles of the lower jaw slip over the eminentia articularis (fig. 334), immediately following this the

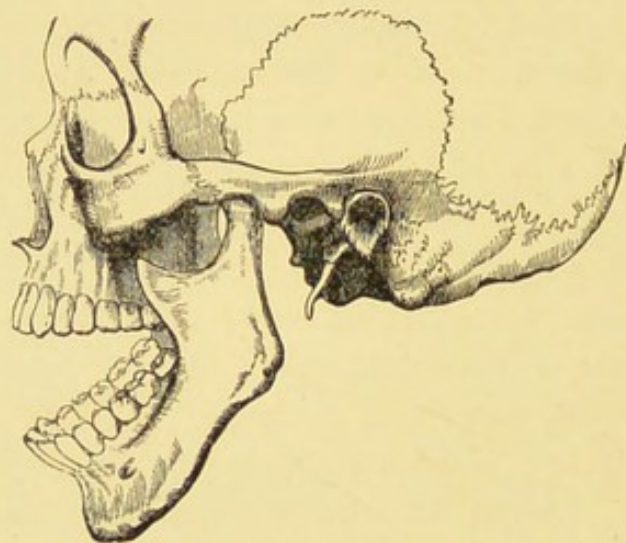


FIG. 334.

masseter and internal pterygoid contract drawing the jaw forwards and upwards. The capsular ligament is but seldom torn, being usually only stretched.

The *symptoms of bilateral dislocation* are that the mouth is open and fixed, the lips cannot be closed, while there is a dribbling of the saliva. If the region of the joint be examined a hollow will be felt behind the condyles and a prominence will be noted immediately above the zygoma; this, according to Christopher Heath, is probably due to spasmodic contraction of the temporal muscle.

In *unilateral dislocation* the mouth is open and fixed, a hollow being apparent behind the condyle dislocated, the chin being drawn to the side opposite to the dislocation, this symptom distinguishing it from fracture of the neck of the condyle, in which case the chin is drawn to the side affected. The dislocation

may be complicated with fracture or extensive laceration of the tissue in the neighbourhood of the joint. Cases of congenital dislocation are on record, while in some instances the condition may be overlooked and become, unless operative treatment is pursued, permanent.

A condition somewhat connected with the accident under consideration is "sub-luxation." This was first described by Sir Astley Cooper, and is an affection in which the patient complains of a constant clicking on opening the mouth, with occasional difficulty in the movement of the mandible. This condition, usually seen in young women of delicate type, was previously thought to be due to a lax condition of the ligaments, but is now generally considered to be due to changes in the joint, the result of rheumatoid arthritis.

The reduction of dislocation of the jaw when quite recent, such as occurring during extraction of the teeth, can be easily carried out by placing the thumbs on the molar teeth, the fingers being placed beneath the chin, a downward force being used with the thumbs, and an upward one with the fingers. It is advisable to wrap some lint or a towel round the thumbs so as to prevent them being injured. Should this method fail, corks or some similar wedge should be placed between the molars, and this will allow more pressure to be applied at the chin and so increase the leverage. In old-standing or difficult cases chloroform should be given, as this will bring about muscular relaxation. After reduction a four-tailed bandage may be worn for a week or two, the jaws being used as little as possible. In patients accustomed to repeated dislocations the use of an elastic support should be advised.

CHAPTER XVIII.

NECROSIS OF THE JAWS.

NECROSIS affecting the jaws may be very slight or considerable in amount. It may be limited to a small fragment of the alveolar portion or involve the greater part of the bone. Necrosis is more common in the lower than the upper jaw, on account of the exposed position of the former, its smaller blood supply, and the fact that it is composed principally of compact tissue, since necrosis more frequently attacks compact than cancellous tissue. The immediate cause of the necrosis is interference with the blood supply either from the medullary or periosteal vessels, brought about by inflammation or the presence of new deposits, such as gummata, tubercle.

The principal exciting causes are:—(1) Extension of inflammation from diseased teeth or the antrum; (2) escape of arsenious acid, used for devitalising a pulp, upon the gum or through the apex of the tooth; (3) direct violence from blows or careless extractions; (4) specific inflammations, such as cancrum oris or ulcerative stomatitis; (5) inhalation of the fumes of phosphorus or mercury, the former occurring in lucifer match makers and the latter in looking-glass makers; (6) administration internally of such drugs as mercury; (7) the exanthemata; (8) the presence of tuberculous deposits, predisposing to inflammation; (9) syphilis, by giving rise to an osteoplastic ostitis, or by the presence of gummatus deposits; (10) malignant disease, such as epithelioma or sarcoma; (11) in many cases it is apparently idiopathic.

The subject will be discussed firstly upon general lines, and secondly, special forms will be considered. In the lower jaw the disease generally attacks the outer side of the alveolus first, and if relief is quickly afforded the inner side may escape. The symptoms of necrosis in the early stages simulate periostitis, the gums being much swollen and tender, abscesses forming, which burst, leaving sinuses; while the teeth become very loose, pus oozing up by the sides of them. The skin may be shiny, red, œdematous, and the breath foetid. In severe cases gangrene may ensue, with a rapidly fatal termination.

The *diagnosis of necrosis*. It is likely to be confounded with epithelioma of the gums which has spread to the antrum (creeping epithelioma), or it may be mistaken for sarcoma. Dead bone can be recognised by the fact that a probe passed down a sinus and impinging upon the bone will give a grating sensation. In children the sequestrum frequently involves the permanent teeth, while in cases of phosphorus necrosis it presents a peculiar appearance known as the pumice-stone deposit, which will be referred to subsequently. This peculiar appearance may occur in other forms of necrosis, though not so frequently as in that caused by phosphorus. The repair following the removal of the sequestrum is, in the upper jaw, generally due to fibrous tissues; but in the lower the periosteum and surrounding tissues are very active in the production of new bone; and in a notable case recorded by Mr. Savory (*Roy. Med. Chir. Soc. Trans.*, vol. lvii., pp. 187-191) the whole jaw was removed from a lad aged eighteen, and six months after, when death occurred, a new jaw had practically re-formed in two pieces.

Treatment.—In the early inflammatory stages any local cause should be removed and local depletion carried out by either scarification or leeches, and hot poppy fomentation applied. A good purge must be given, and, in addition, Christopher Heath recommends large doses of iodide of potassium, opium being added when there is much pain. Should destruction of the bone seem probable, free incisions must be made to relieve tension, while loose teeth should be removed. The health must

be supported, and if solid food cannot be taken fluids must be given. If the bone is necrosed, but immovable, the case should be left alone for nature to throw off the sequestrum. If more than one sinus exists they should be connected, and deodorant mouth-washes prescribed. Directly the bone is loose it must be removed with suitable instruments. When the necrosis involves large portions of the jaw surgical interference may be called for, but should not be carried out until the new bone developed from the periosteum is sufficient to maintain the form of the jaw. For the method of procedure the reader is referred to one of the manuals of surgery.

Phosphorus necrosis.—This form of necrosis was described first by Lorinser, of Vienna, while Dr. Wilks was the first English writer upon the subject. It is an acute and severe form of disease, and may affect both jaws, though usually only one at a time.¹ For the phosphorus to attack the bone there must be some communication from the surface to the deeper parts of the bone, this is generally through a dead tooth or the socket of a recently-extracted one. The action of phosphorus fumes must be prolonged, and be under particular conditions of temperature. The disease is prevalent in those employed in manufactories connected with phosphorus, and was formerly common amongst lucifer match makers. Von Bibra's experiments on rabbits show that phosphorus is actually the cause of necrosis. He found that by extracting teeth, fracturing the jaw, and then exposing the animal to the fumes of phosphorus, symptoms appeared identical to those seen clinically in man. And, further, a case has been recorded of a child, seven years old, who was in the habit of playing with matches, and who became affected by phosphorus necrosis.

The sequestrum from cases of this form of necrosis are peculiar in presenting upon themselves a deposit known as the pumice-like bony deposit. This is found in sequestra from the lower, but not in those from the upper-jaw. It is formed from the

¹ In 51 cases collected by Von Bibra, 5 occurred in both jaws, 21 in the upper, and 25 in the lower.

periosteum, but is so closely adherent to the sequestrum as to be generally brought away with it. A point of interest in regard to the structure of the deposit is that the Haversian canals are larger than in normal bone; they run at right angles to the general direction of the bone, and not parallel to it; they interlace with one another, and in some places form sac-like expansions. Although this peculiar deposit is generally seen in cases of phosphorus, it may occur in other forms.

The *symptoms* of this disease generally commence with toothache, which is at first local and constant, and later becomes more severe and erratic, the pain shooting to the side of the head and towards the shoulder. The disease is at first subacute. The gums become swollen and livid, the swelling and tenderness increasing, and suppuration eventually takes place. The skin over the part becomes red, tense, and distended. Bronchial and pulmonary symptoms from irritation may develop, while later, during the advent of suppuration, there is often well-marked pyrexia, accompanied by rigors. The sufferings of the patient are much mitigated by the discharge of the pus.

Exanthematous necrosis.—This is a disease which follows on the exanthemata. It generally occurs between the ages of three and eight, being most frequent between the ages of five and six. It usually starts within the fourth or fifth week following convalescence from the fever, although it may be as late as the eighth or ninth. It seems especially prone to follow scarlet fever, less frequently measles, smallpox, typhoid, or typhus. The disease may attack both jaws, and may be symmetrical; it may be limited in extent to one tooth, or involve a large portion of the jaws. The necrosis usually attacks the permanent teeth as well as the temporary, although in some cases the crypt of the permanent teeth may come away, leaving the tooth sacs behind. Such cases only, as a rule, involve the alveolar portion of the jaw. When the necrosis supervenes, the patients are often quite healthy. The severity of the fever seems to be no criterion to the amount of necrosis; it is also interesting to notice that the age at which the disease is more frequent is when the greatest nutritional changes are in progress.

Symptoms.—In this form of necrosis, swelling and pain are, as a rule, not so marked as in some of the other varieties. The gums become stripped off from the margin of the jaw, leaving the alveolar border bare. From the margin of the gum pus oozes, and the peeling of the gum progresses in a vertical, and not in a lateral, direction, until the sequestrum becomes loosened, and is easily removed. There is no thickening or effort to form supplemental bone. The breath is generally fœtid, and there may be some rise of temperature. One side generally starts a little time after the other. Necrosis following the eruptive fevers must probably be regarded in the light of one of the specific sequelæ which are prone to follow these fevers. Mr. Salter, who paid so much attention to this form of disease, regards it as “essentially the same as the maxillary necrosis in the victims of phosphorus fumes. It is the result of the local application of a specific poison to the vascular parts of teeth. There is this difference, however, that in the cases we are now considering, the poison is generated within the individual, but with affinities for certain structures, and tendencies to action upon certain organs, which gives its morbid consequences an equally local character.”

The recognition of dead bone in these cases may be of importance from a medico-legal point of view. A sequestrum of a portion of the jaw is usually of a dirty, yellowish-white colour, but it may become deep brown and blackish if exposed to the air. The margins are ragged, and have a worm-eaten appearance, especially at the detached surface.

CHAPTER XIX.

SUPPURATION (EMPYÆMA) IN THE ANTRUM.

THE chief antral disease coming under the notice of the dental practitioner is suppuration in the antrum, the result of acute or chronic inflammation of its lining membrane, which is a tissue similar to that of the nose. The causes giving rise to this condition are—(1) Extension of inflammation from the roots of the teeth, generally from the first or second molar; (2) extension of inflammation from the nasal cavity; (3) injury, such as a blow on the cheek; an instance is recorded in an infant two weeks old of its occurrence as a result of pressure during birth; (4) an abscess burrowing into the cavity, the origin of the abscess being in some other part of the maxilla; cases of abscesses in connection with centrals, laterals, and canines opening into the antrum have been recorded; (5) presence of a foreign body in the cavity, such as a tooth, piece of steel, or portion of drainage tube.

Symptoms.—An early symptom of suppuration in the antrum is a dull, deep-seated pain shooting to the forehead and over the face; but the pain may be of a stabbing, neuralgic character. Tenderness in the region of the malar bone, with slight redness, swelling, and heat of the soft parts, is generally present. In acute cases general febrile symptoms may be present accompanied by a rigor. As the pus forms it makes its way through the opening into the nose, this being especially marked when the patient lies upon the opposite side of the face. The fœtid odour

arising from the discharge is apparent to the patients themselves, and not always to those around, thus differing from ozæna ; but it must be remembered that suppuration in the antrum is often associated with ozæna. In very chronic cases pain may be altogether absent, the patient simply complaining of the discomfort of the discharge and the coughing up of inspissated mucus in the morning.

At times the opening of the antrum into the nose becomes occluded, with the result that the pus begins to collect in the antrum, leading to distension of its walls. The bulging of the facial wall is most marked, and gives rise to a rounded swelling under the region of the malar bone and a globular swelling in the sulcus between the gums and cheek. The orbital surface may also be pushed upwards, leading to protrusion of the eye. The nasal wall, being protruded, will lead to more or less obstruction on that side. The teeth on the affected side may appear elongated and the palate more or less depressed. The pain under these conditions is often of a severe lancinating character. If left alone, the pus will work its way through one of the walls, opening, in some cases, on the face near the posterior internal angle of the orbit. Suppuration of the antrum may lead to necrosis, more or less extensive, of the jaws, and the inflammation may spread to the orbit, producing amaurosis and fixed pupil. In one case, recorded by Dr. Mair, of Madras, suppuration within the cranium supervened, accompanied by epileptic convulsions.

The diagnosis of suppuration in the antrum is not as a rule difficult. A purulent discharge from the nose, accompanied by a dull, deep-seated pain, is always suspicious of antral suppuration, and the principal other trouble for which it is likely to be mistaken is ozæna ; but, as mentioned above, in the latter the breath is offensive to bystanders, but not to the patient, while the contrary is the case in suppuration of the antrum. The presence of diseased teeth in the molar or bicuspid region would assist in the diagnosis, while, in doubtful cases, illumination of the antra by an electric light in the mouth (the patient

being in a totally dark room) will considerably assist. The antrum, under these circumstances when diseased, appears opaque, but if healthy, translucent. When the suppuration is complicated with bulging of the walls, it will be necessary to diagnose firstly, from solid growths, and then from the fluid swelling caused by dental cysts, dentigerous cysts, and cysts of independent formation. This was referred to in the chapter dealing with the diagnosis of swellings about the jaws (p. 403).

Treatment.—The treatment of suppuration in the antrum is to give free vent to the pus, thoroughly drain the cavity, in the same way as in the case of suppuration in other parts. For giving vent to the pus it will be needful to “tap” the antrum at some point. If diseased teeth are present, these should be removed, and the antrum perforated through the socket of the extracted tooth; and when possible that of the anterior buccal root of the first molar should be chosen, because this root opens into the antrum more frequently than any other. When the teeth are sound and living the canine fossa is the best situation for opening into the antrum. To perform the operation, a bone-shaped bur fitted in a socket handle should be used, a small one being used first, followed by a larger: it is important to have a good-sized opening. The bur should be held somewhat like an elevator, the first finger acting as a stop. By adopting a steady rotatory motion, the danger will be avoided of penetrating through the floor of the orbit. Having obtained the opening the cavity must be well syringed with some antiseptic, and if the disease is acute the cavity must be allowed to drain, to permit of being carefully syringed out at first twice, and subsequently once a day.

In treating chronic cases a rather different mode must be pursued. Here the antrum after being syringed should be packed with lint dipped in carbolic acid (1 in 20), or some other irritant antiseptic, the object aimed at being to destroy as far as possible the diseased mucous membrane. If this is accomplished a new healthy membrane develops. The antrum must be thoroughly syringed and packed daily until all discharge

has ceased. The opening made may subsequently be allowed to close. An alternative treatment to the above is to curet the walls of the antrum of Highmore. This operation can only be performed through a large opening made in the region of the canine fossa, and should be carried out with a sharp spoon: the lining membrane is freely scraped, and the case subsequently treated by syringing, packing, and drainage.

There are some cases which come under observation in which the above cannot be carried out because it is impossible for the patient to visit the dentist with sufficient regularity. Under such circumstances, a plate must be made carrying a metal tube, which passes into the antrum. By this means the patient is himself able to syringe out the antrum. It is recommended by some that the patient should fill the mouth with the anti-septic, and then by compressing the lips send the fluid into the antrum. Such a method is to be deprecated because of the unnecessary foreign matter which is forced into the antrum from the mouth.

In antral cases, as with chronic abscess, the injections should be frequently changed, and those recommended under that heading will be found useful. There can be no doubt that many chronic abscesses may encroach upon the antrum, but not necessarily involve the mucous membrane, the abscess as it increases separating the membrane from the bone, and so displacing it. The extraction of the offending tooth is the only treatment required.

CHAPTER XX.

TRISMUS.—INTERFERENCE WITH THE MOVEMENTS OF THE TEMPORO-MANDIBULAR ARTICULATION.

IN practice, cases of stiff-jaw are frequently met with, and the treatment of some of them falls within the province of the dental surgeon, while others belong to the domain of general surgery. It is therefore needful that the dental student should be able to diagnose such cases, and, if needful, treat them. By stiff-jaw is meant an inability to open the mouth. This may be complete or incomplete. By this latter it is meant that there is still a slight degree of mobility present. The causes giving rise to this condition may be—

- (1) Infiltration of the soft tissues with inflammatory products, frequently seen in trouble from the lower third molars.
- (2) Spasm of the muscles closing the jaw.
- (3) Diseases of the temporo-maxillary articulation—(a) Arthritis, acute or chronic; (b) chronic rheumatoid arthritis; (c) ankylosis, osseous or fibrous; (d) hypertrophy of the condyle.
- (4) Cicatricial bands stretching between the upper and lower jaws, the result of previous ulceration.
- (5) Exostosis of the zygomatic arch preventing free movement of the coronoid process.
- (6) Ossification of the pterygo-maxillary ligament.

- (7) The presence of tumours external causing impediment to the movement of the jaw.
- (8) Presence of a deep-seated growth.
- (9) Tetanus.
- (10) Strychnine poisoning.

The larger number of cases coming under the care of the dental surgeon arise from the first cause, and it is therefore best to eliminate these first in proceeding with the diagnosis.

When the closure is due to inflammatory effusion into the soft tissues, the patient's face will be found swollen, hot, and tender, although he is generally able to open the mouth to a slight extent. Upon examining the teeth, it will generally be found that inflammatory trouble and suppuration exist around the third molar, sometimes the second, less frequently the first. The commonest cause of this condition is difficult eruption of the third molar.

Closure of the jaws due to spasm of the masseter and other muscles is very rare ; and, when it does occur, is generally due to irritation from an erupting third molar, although trismus may also be caused by irritation of the pulps in the second and first molar. The tonic spasm, which causes this variety of stiff-jaw, may come on quickly or slowly. There will be an absence, to a great extent, of inflammation, and entire loss of power to open the mouth.

Inability to open the mouth without great pain is a symptom of both acute and chronic arthritis of the articulation, and its treatment is included in the treatment of those affections. The *diagnosis* of stiff-jaw from this cause will not be difficult, as the patient will not only complain of pain on attempting to move the joint, but will also complain of tenderness over the region of the joint ; and, on examination, the parts will be found swollen, and tender to the touch.

Chronic rheumatoid arthritis only leads in its early stages to stiffness of the jaw, which is felt more in the morning, the patient complaining that there is slight difficulty and pain in eating his breakfast. On opening the mouth, a clicking sound

is apparent, not only to the patient, but also to the surgeon. The stiffness of the jaw increases in severity, until, in the most advanced cases, the articulation is practically fixed, due of course to the alterations in the shapes of the articular surfaces, which are a result of this disease. We may suspect this as a cause when the patient gives us a history of gradual loss of power to open the mouth, where it occurs in people of forty years old and upwards. On examining the region of the joint, a hard swelling will be felt which may be unilateral or bilateral, according as to whether one or both sides are affected. The jaw will be seen to have slight mobility; and, on feeling over the region of the joint, a sensation of grating may be felt.

Osseous or fibrous ankylosis, caused, the one by an actual osseous union between the joint surfaces, and the other by the intervention of fibrous bands, may be suspected when the patient gives a history of previous injury or inflammation in the joint. On examination, it will be found in the osseous ankylosis, the immobility is complete; while in the fibrous, the slightest movement can be obtained.

Hypertrophy of the condyle.—In this condition the side of the face on which the hypertrophy exists appears swollen over the region of the articulation. The chin is pushed to the opposite side, and the face distorted on the affected side. The movements of the jaw are restricted.

Cicatricial bands stretching between the upper and the lower jaws are a common cause of stiff-jaw. The patient generally gives a history of there having been previous ulceration, of either a strumous or syphilitic origin, or arising from some form of stomatitis, the ulceration being followed by formation of cicatricial tissue. This form of stiff-jaw may occur at any time of life, and continue unless treated.¹ Examination of the mouth will show a band of fibrous tissue stretching vertically between the jaws.

Exostosis of the zygomatic arch and ossification of the pterygo-maxillary ligament are very rare. In the former condition an

¹ In one case seen the patient had suffered from closure of the jaw for forty years as a result of ulcerative stomatitis.

examination of the zygomatic arch at once makes the condition plain ; and, in the latter, a stiff band is felt in the region of the pterygo-maxillary ligament. Patients affected by these forms of trismus are as a rule of a gouty or rheumatic diathesis.

Tumours pressing upon the jaw from without may occur in the parotid or sub-maxillary regions, or in the situation of the deep cervical glands along the border of the sterno-mastoid muscle. The diagnosis of stiff-jaw from this cause will present no difficulty.

Deep-seated malignant tumours may lead to interference with the mobility of the jaw. Cases of this character are recorded by Coleman, Tomes, and others. This condition may be suspected when, after careful examination, other causes of immobility of the jaw can be eliminated.

Tetanus and strychnine poisoning each lead to trismus. They are less frequently met with than other causes, and are recognised by the presence of the symptoms of a general character to which they give rise.

The *diagnosis* of the causes giving rise to closure of the jaws is best carried out by one of exclusion, and in doing this the more frequent cause should be considered first. They may be taken in the following order:—the joint suppuration around, and irritation from, the molar teeth ; the presence of cicatricial bands ; arthritis ; ankylosis ; hypertrophy of the condyle ; growths pressing from without ; and lastly, such rare conditions as exostosis of the zygomatic arch and tetanus.

The *treatment* of closure of the jaw will depend upon the cause. It consists of the administering of an anæsthetic, forcibly opening the mouth, and removing the offending tooth or teeth. Some little difficulty may be met with in opening the mouth. For most cases a Mason's mouth-gag is generally quite sufficient, but when the degree of trismus precludes the use of this instrument in the first place, the mouth can usually be forced open by a graduated wedge or spiral cone of box-wood. Instruments, such as Heister's mouth-opener, are made for forcibly opening the mouth ; if these are employed very great care must

be taken that the teeth are not fractured or forced out of their sockets. Following the extraction of the tooth, poppy head fomentation should be advised. The time of complete recovery of the free movement of the jaw will depend very much upon the severity of the case. When it is not practicable to remove the third molar, relief may be given by extracting the second. If the trismus is due to acute arthritis, wedges should be placed between the molar teeth and a four-tailed bandage applied, as by this means the articulating surfaces will be separated, and so relieved from pressure. Over the region of the condyle an application of the tincture or liniment of iodine should be made, and purgatives administered.

In chronic rheumatoid arthritis the treatment in the early stages must be constitutional rather than local. The patient should be advised to avoid, as far as possible, exposure to the weather. To those whose occupation causes them to be much in the open air a cap with folds to tie over the region of the joint is to be recommended. A certain amount of relief may be obtained by careful massage of the joint and by rubbing in sulphur ointment over the affected region, sulphur and guaiacum being at the same time given internally. In the more advanced stages, when the jaw has become more or less ankylosed, the operation of excision of the condyle or section through some part of the ramus may be practised.

Osseous and fibrous ankylosis require for treatment the formation of a new joint; while for hypertrophy of the condyle excision of the joint may be necessary. Cicatricial bands can be treated by division of the cicatrices or the formation of a new joint, the latter being now generally adopted. Exostosis of the zygomatic arch and ossification of the pterygo-maxillary ligaments would, if met with, be probably treated by the formation of a new joint. If the trismus is due to external swelling, the treatment will consist in seeking for, and, if possible, removing, the cause of the swelling.

The three most usual operations devised for the relief of stiff-jaw are :—

- (1) Excision of the condyle ;
- (2) Resection of a V-shaped portion of the ramus (Esmarch's operation) ;
- (3) Division of the horizontal ramus in the region of the masseter muscle (Heath's operation).

(1) The condyle is excised by exposing the bone by an incision, the situation of which varies according to the operator, some adopting one and some another. The neck of the condyle is then sawn through and removed with forceps. (2) Esmarch's operation is performed by making an incision about two inches in length along the lower border of the body of the jaw, and then by means of a saw removing a wedge-shaped piece, the base of the wedge being below. In one case recorded by Heath the base measured half an inch, the apex a quarter, while in another which he records the base was seven-eighths of an inch. (3) Heath's operation is best described in his own words :—“ I made a small incision within the mouth immediately above the last molar tooth, and having passed a steel director to clear the way, I was able to push an Adams' saw beneath the masseter and to divide the ramus horizontally.”

Of the different operations, each has its own advantages, Heath contrasting the three methods as follows :—“ In cases of cicatrix I give the preference to Esmarch's method of removing a wedge from the lower jaw on one or both sides. The operation is a comparatively easy one, and in cases where only one side of the jaw is affected, restores the patient to a very useful though one-sided amount of masticatory power in two or three weeks, and with very little suffering or annoyance. In cases of fibrous ankylosis of the temporo-maxillary joint it may be worth while to try division of the adhesions, and, failing that, to resect the condyle. In cases of bony ankylosis of the joint division of the ramus of the jaw beneath the masseter appears to me the least dangerous and most satisfactory proceeding.”

CHAPTER XXI.

DISEASES DUE TO THE PRESENCE OF DISEASED TEETH.

IN a previous chapter an endeavour was made to show how any irritation of distant portions of the fifth nerve or its connections may give rise to odontalgia ; in this chapter we propose to deal with those conditions which are supposed occasionally to be due to the presence of diseased teeth. The subject is one beset with many difficulties, first on account of the comparative scarcity of recorded cases ; secondly, from the fact that of the instances recorded many have been incompletely described ; thirdly, that a large number of those recorded are capable of different explanations to those offered by the observers. It is quite probable that in many cases, through anxiety to attach too much importance to the influence of teeth, a fallacious diagnosis has been arrived at, a coincidence of diseases being wrongly associated in a causal relation. Cases of supposed disease dependent upon dental trouble should always be thoroughly investigated and care taken to eliminate any other cause, and cases should only be reported when it can be conclusively proved that there is a distinct connection between the dental cause and the effect. It would also be an advantage if in doubtful cases a consultation could be arranged between the medical and dental practitioners rather than a mere transference of the patient from one to another. In the scope of this work it is impossible to attempt anything like a complete account or criticism of the cases which have

been reported. Reference by footnotes is given to the cases quoted.

Epilepsy and convulsive seizures would appear to occasionally arise from dental irritation, and cases illustrative of this have been recorded by Coleman,¹ Portal,² Tomes,³ and Ramskill.⁴ The one related by the latter is very interesting:—"A boy, thirteen years old, has had frequent attacks of epilepsy for the last eighteen months. Latterly his mother has noticed that some days he rubs his left cheek, complaining of face ache, after which the fit follows. On examining the mouth there is to be seen a molar tooth considerably decayed, with a swollen gum around it and partly growing into the cavity; it is not very tender to the touch and the examination does not give rise to toothache. On questioning, I find the sensation which the boy experiences before a fit does not seem to be one of pain, but rather of an indefinite uneasiness. He always has a fit the night this comes on. Has never felt it during the day; it is always about seven or eight o'clock. I desired the mother to have the tooth extracted and ordered a simple saline with a quarter of a grain of belladonna to be taken twice daily. This was in June. The tooth was extracted next day. I saw this boy once a fortnight from that time for four months but he has had no recurrence of the fit. In this case I believe an unfelt aura commenced about the gum surrounding the tooth and was not recognised till some degree of inflammation arose, thus a modification of pain became associated with the aura and directed attention to it."

That epilepsy may be caused by dental as by any other peripheral irritation is quite possible, for Dr. Brown Sequard found that after section of one of the lateral columns of the cord anywhere between the medulla and tenth dorsal vertebra epilepsy could be produced by very slight irritation of the fifth nerve. A case of some interest, also, came under the observation of one of

¹ *British Journal of Dental Science*, 1863.

² Portal's *Observations sur l'Epilepsie*, p. 333.

³ Tomes, *Dental Surgery*, p. 567.

⁴ *Medical Times and Gazette*, 1862, vol. ii. p. 216.

the authors—"A patient, aet. 22, a male, always showed distinct signs of *petit mal* during the operation of stopping, the symptoms being always more marked if an exposed nerve was touched." This patient, to the best of his recollection, had never suffered at any time with epilepsy or had had fits of any other character.

Hysteria,¹ conditions resembling somewhat in character the symptoms of insanity² have also been recorded, associated with dental irritation, as well as *violent palpitation*,³ *stoppage of the heart's action*,⁴ and *pain referred to the uterus*.⁵

Certain muscular affections have been reported as directly traceable to dental origin. For instance, a case of *inability to raise the arm*, accompanied by loss of grasp of the hand, is recorded by Salter⁶ as due to a carious wisdom tooth, while *spasmodic closure of the jaw* is also said to occur. Reference to this latter has been made in a previous chapter. A case of *wry neck* (spasmodic contraction of the sterno-mastoid and trapezius muscles) is related by Hancock,⁷ while one of *tetanus*, following pivoting, is given by Sir John Tomes.⁸ That this last affection could arise from reflex irritation is hard to understand, since it is now proved to be due to the presence of a specific micro-organism, and cases following dental operations are probably explicable on the assumption of infection having taken place during the operation.

Facial paralysis is found at times associated with dental irritation, and in reading the history of some of the cases recorded the trouble from the teeth would appear to have played a prominent part in the causation of the paralysis. Interesting records are

¹ Richardson, *Diseases of the Teeth*, p. 93.

² Corbett, *Transactions of International Medical Congress*, 1881, p. 475.

³ Remak, *Sydenham Society's Year Book*, 1868, p. 120.

⁴ Ainslie, *Neuralgia*, 1871.

⁵ Sercombe, *British Journal of Dental Science*, vol. iii. p. 221.

⁶ Salter, *Guy's Hospital Reports*, 1868.

⁷ *Lancet*, 1859, vol. i. p. 80.

⁸ *Lectures on Dental Surgery* by John Tomes, 1848, p. 321.

given by Poundall,¹ Garretson, and Salter, while Gabriel² reports a case where facial paralysis was apparently the result of extraction. The patient, a healthy, well-made man, had a left lower molar and wisdom stumps extracted at 12 noon, and on recovering stated that his right cheek felt stiff, which may or may not have been due to the gag. At 3 p.m. the same day, the left upper molar, right upper, and right first lower molar stumps were removed, and, after recovery, there was inability to close the right eye, with other symptoms of paralysis. The patient eventually recovered. How these reflex paralyzes (if such they be) are produced is doubtful; but it must be remembered that the facial nerve is connected with three of the ganglia in connection with the fifth nerve, namely, with Meckel's by the greater superficial petrosal nerve, with the otic by the lesser superficial petrosal, and with the submaxillary through the chorda tympani. All points considered, a careful examination of the teeth should be made in cases of facial paralysis, but care must be taken not to extract teeth which, with careful treatment, can be saved.

Hemiplegia,³ **paraplegia,**⁴ **and even general paralysis**⁵ of supposed dental origin have been recorded, but a careful perusal of some of them would point to hysteria being the cause.

That disordered nutrition may follow upon dental irritation is undoubted, and a curious point in this connection is the fact that the *tongue is often found furred* on the same side as the diseased teeth. *Increased flow of saliva*, leading to a large deposit of tartar, and *increased secretion of tears*, are also found, while *dyspepsia* may arise through the imperfect mastication and insalivation of the food.

Chronic or acute inflammation of lymphatic glands is at times traceable to septic infection from the teeth, and these are probably very much more frequently the cause of such trouble than is

¹ *British Journal of Dental Science*, 1879, p. 56.

² *British Journal of Dental Science*, 1885, p. 359.

³ Suesserott, *Dental Cosmos*, Nov. 1868.

⁴ Corbett, *Transactions of International Medical Congress*, 1881, p. 476.

⁵ Levison, London, *Lancet*, 1851.

generally appreciated; the extraction of the diseased teeth without medicinal treatment will frequently effect a cure.

Herpetic eruptions upon the face may arise from reflex irritation from the teeth, while, through inflammation spreading from the teeth, the *skin* may become involved, and so *undergo sloughing and ulceration*.¹

Otalgia (earache) is often due to irritation from the teeth, arising probably through the intimate relation existing between the fifth and other cranial nerves. An interesting case of *otorrhœa*, proceeding from slight ulceration in the auditory canal, is recorded by Tomes² as being due to a carious lower molar.

A large number of cases of affections connected with the eye have been recorded as being due to dental origin. Two papers of great interest in this connection have been read in recent years before the Odontological Society.³

Loss or failure of the power of accommodation, due to paresis of the ciliary muscle, has been particularly investigated by Schmidt, of Berlin. This observer examined ninety-two cases suffering from caries of the teeth, periostitis, or neuralgia, and found that in seventy-three instances the range of accommodation was lowered. His facts tend to show that there may be a connection between the two; on the other hand, Collins, who has paid much attention to this subject, is of the reverse opinion; and, further, Priestley Smith examined sixteen persons suffering from toothache, and in fifteen of them found no anomaly of accommodation.

Certain paralytic affections of the intrinsic and extrinsic muscles of the eye are recorded, giving rise to **mydriasis**⁴ (a condition in which the pupil is dilated and motionless), **ptosis**⁵ (paralysis of the levator palpebræ), and **strabismus**¹ (squint); but it is questionable if they are ever traceable to dental disease.

¹ Salter, *Guy's Hospital Reports*, 1868.

² *Dental Surgery*, 3rd edition, p. 572.

³ *Trans. Odontological Society*, vols. xvi. and xxiii.

⁴ See Mr. Power's paper, *Trans. Odontological Society*, vol. xvi.

⁵ *Lancet*, April 9, 1881.

Lagophthalmos (hare-eyed) means a watery looking eye, in which the tears are ready to overflow, while the lids look red at the edges. An interesting case of lagophthalmos² is recorded by Mr. S. J. Hutchinson, the eye trouble being apparently traceable to a first upper molar. Spasm of the muscle of Müller, which is supplied by the sympathetic, may be the explanation of this case.

Spasm of the orbicularis palpebrarum occasionally arises from dental irritation.

Severe neuralgia in the orbit may occur, and probably arises from irritation of the fifth nerve.

Conjunctivitis is often found associated with dental lesions, and Mr. Power seems to think that *phlyctenular conjunctivitis* may in the same way be associated with them.

A large number of cases of **amaurosis**³ (loss of sight without perceptible ocular lesion) have been recorded, but it is doubtful if amaurosis ever arises from reflex irritation. A careful perusal of many of the recorded cases rather tends to show that the eye trouble was the direct extension of inflammation from the diseased teeth through the maxilla. It is indeed quite possible, as Collins remarks, that "such cases become more frequent in literature as we recede into pre-ophthalmoscopic and less critical times, and become rarer and seem to disappear when they are most vigilantly and critically inquired for."

Glaucoma is the term applied to that condition of the eyeball when intra-ocular tension is abnormally high. Mr. Power is of the opinion that this condition may be caused by dental disease; it is however very questionable, and there are many ophthalmic surgeons in large practice who have never seen cases which would support this idea.

¹ Hancock, *Lancet*, 1859, p. 80.

² *Trans. Odontological Society*, vol. xviii. p. 7.

³ Galezowski, *Archives générales de Médecine*, tome xxiii. p. 261.

CHAPTER XXII.

SOME COMMON AFFECTIONS OF THE TONGUE MET WITH IN THE COURSE OF DENTAL PRACTICE.

CERTAIN diseases of the tongue, more especially epithelioma, may come under the notice of the dental practitioner before their presence is recognised by the patient, and, as their early recognition is most important, it has been deemed advisable to introduce a chapter in which reference will be made to those affections more frequently met with.

Chronic superficial glossitis is a disease very insidious in its onset. It is a chronic inflammation of the mucous membrane of the tongue, the commencement of the trouble being situated in the papillæ. In the earliest stages these are in a condition of hyperæmia, but, as the disease progresses, an excessive growth of the epithelium takes place. The superficial layer of the epithelium becomes opaque, and by the coalescence of neighbouring spots, whitish patches are formed upon the surface of the tongue, the organ appearing as if milk had been thrown upon its surface. Atrophy of the papillæ next takes place, so that the surface becomes smooth and still whitish in colour. Cracks and fissures may now appear and superficial ulcerations form, the disease in many cases degenerating into epithelioma. The affection, in its early stages, does not cause much discomfort, and is therefore seldom recognised by the patient. In the later stages, however, pain becomes a prominent symptom. The disease is very much more prevalent in men than women, and has as predisposing causes

excessive smoking or spirit drinking, syphilis, and dyspepsia. Nearly half the cases end in epithelioma, and it is therefore important that the condition should be early recognised and treated.

Ulcerations of the tongue.—The ulcers of the tongue may be divided into

- (1) Simple—(a) Dental or irritable.
(b) Dyspeptic.
- (2) Epitheliomatous.
- (3) Syphilitic—(a) Superficial.
(b) Deep.
- (4) Tuberculous.
- (5) Rodent.
- (6) Lupoid.

The simple irritable ulcer generally occurs in the region of the bicuspid teeth, the cause being a sharp edge of tooth, tartar, etc. In some cases the ulceration is quite superficial, but, nevertheless, very painful, both on speaking and eating. The surface is usually surrounded with a zone of inflammation. In other cases the ulcer extends deeper, the edges being irregular and abrupt, the surrounding mucous membrane inflamed, and the floor of the ulcer bathed with pus. The base, however, is not indurated; thus is distinctly separate from epithelioma. *Treatment* consists in removing the cause.

Dyspeptic ulceration is more frequently met with near the tip of the tongue on the dorsal aspect. The ulcers are generally multiple and superficial, the portion of tongue around them being nearly always slightly inflamed, while symptoms of dyspepsia are present. *The treatment* consists in attending to the dyspepsia, employing chlorate of potash mouth-washes, and if the ulceration is very severe, brushing the surface of the ulcers with nitrate of silver.

Epitheliomatous ulceration of the tongue being of a malignant nature, its early recognition is extremely important. It may arise from—(1) Neglected irritable ulcers; (2) old syphilitic cracks and chronic fissures; (3) chronic superficial glossitis; (4) warts. It

commonly commences as a flattened warty growth, which breaks down into an ulcer and spreads rapidly. The characteristics of an epitheliomatous ulcer are as follows:—(1) Raised, sinuous, hard and everted edges; (2) the surrounding mucous membrane indurated; (3) the floor irregular, and covered with a foul discharge; (4) the base indurated, and in the later stages the tongue fixed; (5) a darting pain; (6) profuse salivation; (7) enlargement of the neighbouring lymphatic glands (not in the early stages); (8) interference with speech and mastication; (9) the disease is more prevalent in men than in women; (10) occurs generally in those past the age of forty; (11) usually situated on the side of the tongue.

Treatment is excision of a portion or the whole of the tongue.

As before stated, early recognition is of the utmost importance. The presence of a wart on the side, tip, or, indeed, any part of the tongue, should always be regarded with suspicion, and the patient *at once* advised to seek skilled assistance. All ulcers of anything like long-standing should always be submitted to a careful examination. The particular points to pay attention to are—(1) the history of the ulcer; (2) the character of the edges; (3) the condition of the surrounding mucous membrane. Ulceration in patients over forty is always serious, and in doubtful cases it is better to have the suspicious portion excised.

Syphilitic ulceration of the superficial variety occurs about the sides, tip, and under surface of the tongue. The ulcer may be widespread, presenting crescentic-shaped edges, which are sharply cut, or the ulceration may extend in cracks and fissures, causing scarring of the tongue upon healing.

In syphilitic ulceration, when it is due to breaking down of a gum, the ulcer thus formed is typical. (1) The edges are sharply cut; (2) the surrounding tissue is free from induration; (3) the floor may present a wet-wash-leather-like appearance; (4) the situation of the ulceration is usually the dorsum of the tongue in the median line; (5) the tongue is moveable; (6) speech is not interfered with; (7) the submaxillary lymphatic glands are not enlarged, but indurated glands in other

parts of the body may be found ; (8) profuse salivation is not present ; (9) there is little or no pain.

The *treatment* consists in the administration of anti-syphilitic remedies.

Tubercular ulcers occur on the dorsum of the tongue near the tip, similar in situation to dyspeptic ulceration. The patients in whom tubercular ulceration occurs are usually in advanced stages of phthisis. The disease starts as a small white spot which breaks down and extends. Around this more spots appear, which, in turn, break down and coalesce, giving rise to a large irregular ulcer, with an uneven surface covered with a yellowish discharge. The coincidence of the disease with well-marked symptoms of general tuberculosis or phthisis are sufficient to prevent it being mistaken for either syphilis or epithelioma.

Rodent and lupoid ulceration are extremely rare, and therefore do not call for any description.

CHAPTER XXIII.

DIAGNOSIS OF SWELLINGS ABOUT THE JAWS.

THE diagnosis of swellings in the region of the jaws is not always an easy task. In all cases two points have to be considered: (1) whether the swelling is fluid or solid; (2) whether it be innocent or malignant. For convenience of description the subject will be considered under the following heads:—

- (1) Swellings involving the antrum;
- (2) Swellings in the palate;
- (3) Swellings in connection with the lower jaw.

(1) **Swellings involving the antrum.**—Fluid collections in the antrum give rise to painless and slow distension of the walls, the thinner or facial wall giving way before the more resistant; the bulging on the face is therefore one of the most prominent symptoms. The swelling itself is smooth and globular, and on pressure may give rise to the sensation known as parchment-like crackling. The alveolar border is not, as a rule, interfered with, while in some instances the patient may be cognisant of the sensation of fluid in the antrum.

With *innocent solid tumours* the thicker walls of the antrum are affected as much as the thinner, the alveolar border is therefore displaced, but generally quite regularly; epiphora (overflow of tears) is sometimes present, from pressure on the nasal duct, while neuralgia of a severe character, from pressure on the infra-orbital and anterior-dental nerve, may co-exist.

Malignant tumours generally affect one surface of the antrum

more than the other. The alveolar border is generally displaced in an irregular manner and not as with innocent growths. The nasal fossa is early involved and there is a history of quick growth, with probably frequent attacks of hæmorrhage, severe pain, early implication of the skin, well-marked emaciation, œdema of the face, and probably enlargement of the lymphatic glands.

By attention to the foregoing it is often possible to roughly determine the character of a tumour as to whether it is fluid or solid. If fluid it may be either a dental cyst, a chronic abscess, a dentigerous cyst, or a cyst of independent formation (cystic degeneration of the mucous follicles of the antrum). A careful examination of the teeth should be made, and the presence of stumps or dead teeth ascertained. If these are present the probability is that the swelling is either a dental cyst or a chronic abscess. The differentiation between these two will be assisted by (1) ascertaining the presence or absence of inflammation around the carious teeth and surrounding parts; (2) the history of the swelling. If inflammation is present it will point to a chronic abscess, and the same will be the case if the patient states that the swelling varies in size, or that it came quickly and has remained practically stationary. Absence of inflammatory trouble, and slow but steady growth of the swelling, point to the presence of a dental cyst. If no decayed teeth are present it will be probable that the swelling is either a dentigerous cyst or a cyst of independent formation. The diagnosis between these may be made by observing whether there is an absence of a tooth or teeth from the series. The solid innocent tumours occurring in the antrum are—(1) Fibroma, (2) enchondroma, (3) osteoma, (4) myxoma. The differential diagnosis of these is at times far from easy, more especially in the early stages, as they all give rise to distension of the walls of the antrum. Osseous growths are generally of exceedingly slow development, while fibromata and enchondromata may grow at times with great rapidity.

The malignant tumours occurring in the antrum are—(1) Carcinomata, (2) sarcomata. The differential diagnosis between carcinoma and sarcoma can be made by considering the age of the patient; growths in the young are always *sarcomata*, while those occurring in persons over the age of forty may be either sarcoma or carcinoma. A tendency to bleed will indicate a sarcoma; and growths springing from the region of the malar bone are nearly always sarcomatous. In the case of malignant tumours, a diagnosis should always be made from necrosis, especially when in the latter there is the presence of a large amount of inflammatory material and sloughing of the soft tissue. In doubtful cases a microscopic examination of a portion of the diseased tissue should be made before performing an operation.

(2) **Swellings in the palate.**—In a previous chapter the different tumours affecting the gums have been dealt with, so that here we shall only deal with those swellings which are met with in the palate. These may be divided into fluid and solid. The fluid are—(1) acute abscess, (2) chronic abscess, (3) dental cyst, (4) dentigerous cyst; while the commoner solid growths are—(1) fibroma, (2) exostosis (osteoma), (3) sarcoma, (4) epithelioma. In diagnosing between these the fluid must first be separated from the solid by observing whether fluctuation is present, and also the character of the swelling, whether regular, smooth, and globular, or irregular and nodulated.

The differential *diagnosis* between the fluid tumours is practically similar to that referred to when dealing with swellings in the antrum, and lies between acute abscess, chronic abscess, dental cyst, and dentigerous cyst. With regard to the solid tumours, it must be first ascertained whether the growth is innocent or malignant by questioning as to the rate of growth, etc. If innocent, the difference between a fibroma and exostosis can be ascertained by feeling the consistency of the growth, a fibroma having a putty-like feel, while an exostosis is quite hard. Again, the time occupied by the growth of an exostosis extends over years. Sarcoma and epithelioma, when forming distinct tumours, will be difficult to differentiate. The

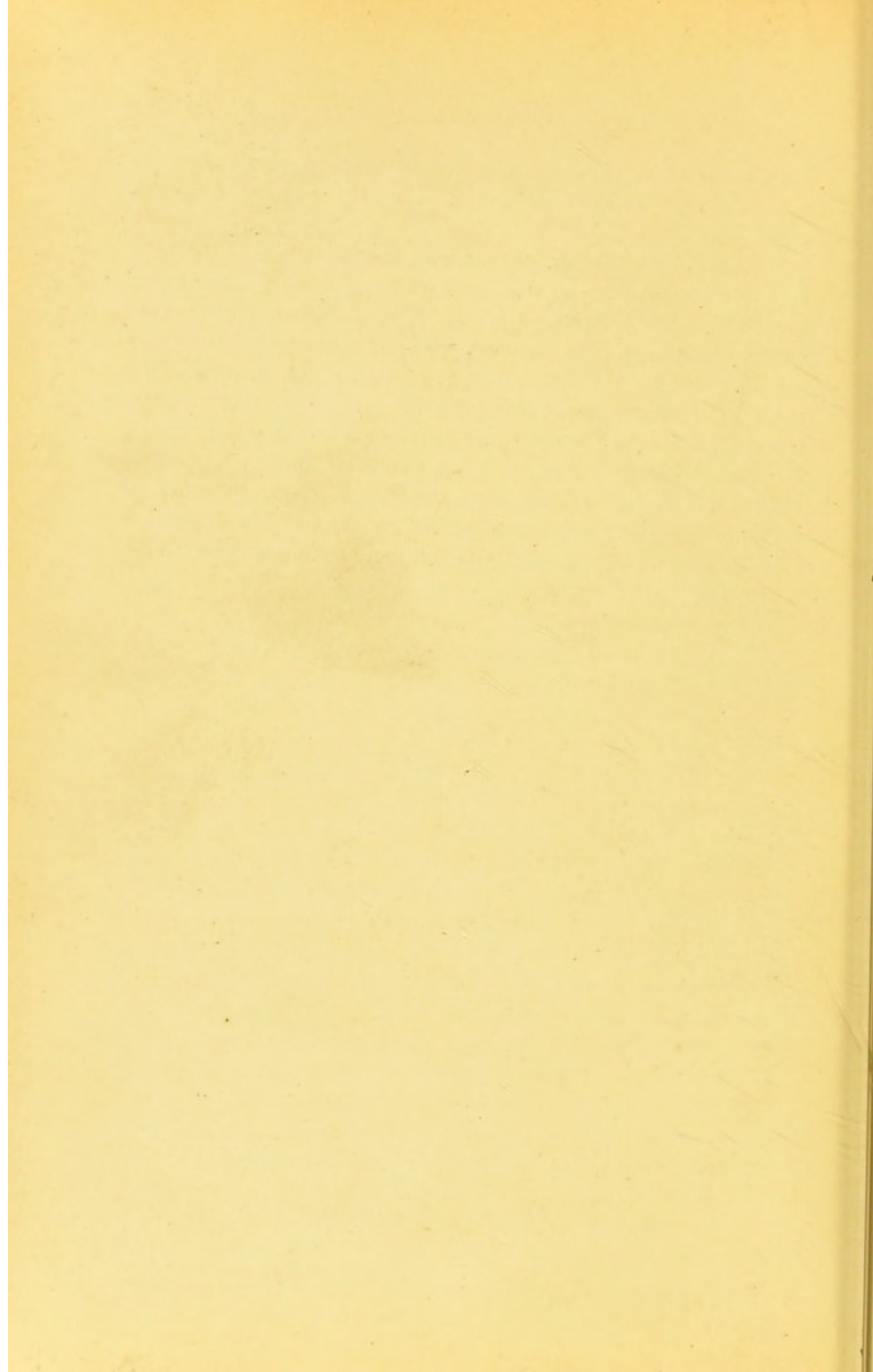
epithelioma has, however, a greater tendency to ulcerate, the sarcoma to bleed.

(3) **Swellings involving the lower jaw.**—In patients presenting themselves with swellings in the neighbourhood of the lower jaw the first step to determine is whether or not the swelling is in connection with the jaw, and, if in connection with it, whether it involves the substance of the bone or is only connected with it externally. Taking the latter class first, the first point is to distinguish between a fluid and a solid tumour by the presence or absence of fluctuation. If the swelling is a fluid collection a differential diagnosis must be made between chronic abscess, dental cyst, and cyst of independent formation, by paying attention to the same points referred to in differentiating the various fluid collections in the antrum and in the palate. If the growth is solid the innocent must first be diagnosed from the malignant. The usual innocent tumours in this situation are fibroma, enchondroma, and osteoma (exostosis). The position of the growth will be of some assistance, since the usual sites of the osteoma (exostosis) are the angle of the jaw, inner side of the horizontal ramus in the region of the canine, and near the mental foramen.

Tumours involving the body of the bone will require rather more care in diagnosis. The principal symptom will be gradual expansion of the two plates of the mandible, the outer generally yielding to a greater extent than the inner. Fluid swellings may be suspected when the bulging of the walls is quite smooth and globular in character, and the outer plate may become so thin that on pressure upon it the symptom of parchment-like crackling may be felt. If the swelling is fluid a diagnosis will have to be made between chronic abscess, dental cyst, dentigerous cyst (follicular odontome), and multilocular epithelial cyst (epithelial odontome). The mode of diagnosis between the first three has already been mentioned. The last, viz., multilocular epithelial cyst, may be suspected if the swelling shows a tendency to be nodular. This form of tumour is likely to be mistaken for a medullary sarcoma, and the diagnosis between

the two is often very difficult, but with the former there will nearly always be an absence of a tooth or teeth from the series.

With solid growths the character of the expansion of the bone is not so regular as in fluid collections, the inner plate being involved as well as the outer. With innocent growths the swelling will be of long duration, while with malignant the swelling is generally nodulated and always of quick growth. The innocent tumours may be either fibrous, cartilaginous, or osseous; the malignant either epithelioma or sarcoma. The usual form of sarcoma is the myeloid, and its diagnosis from multilocular epithelial cyst has already been considered. Necrosis must be carefully separated from malignant disease, and the likelihood of mistaking a calcified odontome for more serious mischief must not be forgotten.



INDEX.

	PAGE		PAGE
Aberrations of the enamel organ,	313	Accommodation, loss or failure of	
follicle, - - - - -	314	the power of, - - - - -	397
papilla, - - - - -	321	Ackery, Mr., on case of abnormality in number of temporary teeth, - - - - -	12
whole tooth germ, - - - - -	323	deficiency in number of permanent teeth, - - - - -	39
Abnormal dentition, - - - - -	27	Actinomycosis, - - - - -	304
Abnormalities of first dentition, - - - - -	9	Mr. Eve on, - - - - -	304
Abnormalities of permanent teeth, - - - - -	31	Action of arsenic, local, - - - - -	239
causes giving rise to, - - - - -	40	Acute abscess, - - - - -	405
in number, - - - - -	32	Acute inflammation of gums during eruption, - - - - -	4
in position, - - - - -	39	treatment of, - - - - -	5
in size, - - - - -	31	Acute inflammation of gum, - - - - -	290
in structure or form, - - - - -	103	treatment of simple, - - - - -	290
too early extraction of deciduous teeth, a cause of, - - - - -	43	treatment of mercurial, - - - - -	291
undue persistence of temporary teeth, a cause of, - - - - -	42	Acute, local odontalgia, - - - - -	357
Abnormalities of temporary teeth, - - - - -	11	treatment of, - - - - -	358
in number, - - - - -	12	Acute, local periodontitis, - - - - -	250
in position, - - - - -	12	treatment of, - - - - -	252
in size, - - - - -	11	Acute, or chronic inflammation of the lymphatic glands from teeth, - - - - -	396
in structure, - - - - -	15	Ætiology of caries, - - - - -	144
Abrasion, - - - - -	284	Affections of the tongue met with in dental practice, - - - - -	399
treatment of, - - - - -	285	chronic superficial glossitis, - - - - -	399
Abscess, alveolar, - - - - -	45, 264	ulcerations of the tongue, - - - - -	400
treatment of, - - - - -	268	Alterations produced by constitutional disturbances, - - - - -	103
acute, - - - - -	405	exanthemata fevers, - - - - -	107
chronic, - - - - -	405, 406	disturbances of nutrition, - - - - -	107
Abscesses, - - - - -	271	use of mercury, - - - - -	107
treatment of, - - - - -	271	gout, - - - - -	111
Absence of temporary and permanent teeth, - - - - -	12	rachitis, - - - - -	106
Absorption, - - - - -	262	syphilis, - - - - -	103
appearance of, microscopically, - - - - -	263	Alterations produced by local disturbances, - - - - -	111
of dentine, - - - - -	234	Alveolar abscess, - - - - -	45, 264
of fangs of temporary teeth, theories on the, - - - - -	22	complications in, - - - - -	266
Accidental removal of neighbouring tooth, - - - - -	343	diagnosis of, - - - - -	267
Accidents, causes of, in using drill, - - - - -	241		
under anæsthetics, - - - - -	342, 353		

	PAGE		PAGE
Alveolar abscess, symptoms of, -	267	Attrition, - - - - -	282
Alveolaris pyorrhœa, - - - - -	271	microscopical appearance of, -	282
ætiology of, - - - - -	273	treatment of, - - - - -	284
treatment of, - - - - -	275	Automatic mallets for filling, -	189
Amadou, Mr. Matheson on use of, -	159	Bands, cicatricial, - - - - -	389
Amalgam, Dr Dodge on prepara-		treatment of, - - - - -	390
tion of cavities for, - - - - -	178	Bands, elastic, - - - - -	61
Dr. Flagg on, - - - - -	208	Bibulous paper, - - - - -	158
Dr Bonwill on, - - - - -	208	Bicuspid, irregularities of, - -	78
Mr. Kirby on, - - - - -	208	Bilateral dislocation of the jaws, -	376
and gold for filling, - - - - -	207	treatment of, - - - - -	377
and osteoplastics for filling, -	210	Bite, edge to edge, - - - - -	14, 96
Sullivan's, - - - - -	102	open, - - - - -	14, 98
Amaurosis, - - - - -	398	underhung, - - - - -	96
Anæsthetics, accidents under, -	342, 353	treatment of, - - - - -	96
extraction under, - - - - -	340	Black, Dr., on areolation of the	
Anchylosis, osseous or fibrous, -	389	pulp, - - - - -	247
treatment of, - - - - -	391	on erosion, - - - - -	280
Angina Ludovici, - - - - -	30	Bleaching teeth, - - - - -	247
Anterior occlusion, lack of (open		Bonwill, Dr., on amalgam for	
bite), - - - - -	14, 98	filling, - - - - -	208
causes of, - - - - -	98	Breathing, mouth, - - - - -	45
treatment of, - - - - -	98	Bronchus, diagnosis of a foreign	
Anterior protrusion of upper front		body in the, - - - - -	354
teeth, - - - - -	91, 92	Brown striæ of Retzius, - - - - -	108
treatment of, - - - - -	93	Bruising the lips, - - - - -	347
Anterior teeth, crowding of, -	80, 86	Calcareous degeneration of the	
Antrum, forcing a tooth into the, -	345	pulp, - - - - -	228
Antrum, suppuration in the, -	383	Calcification of the teeth at differ-	
diagnosis of, - - - - -	384	ent ages, - - - - -	27
symptoms of, - - - - -	383	tissues of the pulp, - - - - -	229
treatment of, - - - - -	385	Calcified epithelial odontome, -	314
Antrum, swellings involving the, -	403	Calculus, tartar or salivary, -	308
Appearance of caries, microscopi-		causes of, - - - - -	309
cal, - - - - -	138	treatment of, - - - - -	310, 311
Appearance of absorption, micro-		Canal filling, materials used for, -	242
scopical, - - - - -	263	gold and copper wire, - - - - -	243
Application of rubber-dam, -	162, 165	gutta percha, - - - - -	242
Approaching eruption of teeth, -		iodoform and wax, - - - - -	243
normal signs of, - - - - -	2	wood, - - - - -	243
Approximal cavities, - - - - -	197	Canals, preparation of the root,	
Arch, cause of contracted, - - - -	87	for filling, - - - - -	240
saddle-shaped, - - - - -	89	treatment of the, - - - - -	240
U-shaped, - - - - -	87	Cancrum oris, - - - - -	296
V-shaped, - - - - -	89	prognosis of, - - - - -	297
Areolation of the pulp, Black on, -	225	treatment of, - - - - -	297
Arrested decay, - - - - -	149	Canines, irregularities of, - - -	72
Arsenic, local action of, - - - - -	239	lower, - - - - -	76
Arthritis, chronic rheumatoid, -	288	Capsicum plasters, - - - - -	253
diagnosis of, - - - - -	390	Caries, - - - - -	134
treatment of, - - - - -	391	ætiology of, - - - - -	144
Articulation, temporo-mandibular,		Caries, artificially produced, Miller	
interference with the move-		on, - - - - -	143
ments of the, - - - - -	387	Magitot on, - - - - -	143
Artificial decay, - - - - -	143	Caries, direct causes of, - - -	146
Magitot on, - - - - -	143	excision of, - - - - -	154
Miller on, - - - - -	143		
Atrophy reticular, of pulp, - - -	223		

	PAGE		PAGE
Caries, general causes of, - - -	145	Cerebral or central referred odontalgia, - - - - -	359
macroscopical phenomena of, -	135	Cheadle, Dr., treatment of rachitis or rickets, - - - - -	9
microscopical appearance of, -	138	Choice of a splint, - - - - -	373
micro-organisms in, - - - -	140	Chorea, - - - - -	30
non-infected zone, - - - -	140	Dr. Sacks on, - - - - -	30
pigmentation in, - - - -	138	Chronic abscess, - - - - -	405
predisposing causes of, - - -	144	Chronic hypertrophic inflammation of the gums, - - - - -	291
theories of, - - - - -	148	Chronic inflammation of the gum, -	291
translucent zone in, - - - -	137	treatment of, - - - - -	292
transparency in, - - - - -	136	Chronic, local odontalgia, - - - -	358
treatment of, - - - - -	151, 154	Chronic, local periodontitis, - - -	254
Caries, in the temporary teeth, - -	17	diagnosis of, - - - - -	255
treatment of, - - - - -	17	treatment of, - - - - -	255
Carcinomata, - - - - -	405	Chronic or acute inflammation of the lymphatic glands, - - - - -	396
Cataract, lamellar, - - - - -	110	Chronic rheumatoid arthritis, - - -	388
Cause of abnormality, too early extraction of deciduous teeth, -	43	diagnosis of, - - - - -	390
undue persistence of temporary teeth, - - - - -	43	treatment of, - - - - -	391
Cause of concussion of teeth, - - -	129	Chronic superficial glossitis, - - -	399
dislocation of teeth, - - - -	130	Cicatrices, a cause of deformation, -	46
caries, theories of, - - - - -	148	Cicatrical bands, - - - - -	389
erosion, - - - - -	280	treatment of, - - - - -	390
fracture of teeth, - - - - -	131	Clamps, Mr. C. Stokes', - - - - -	158
ranula, - - - - -	305	various, - - - - -	162
Causes of accidents in using nerve canal drills, - - - - -	241	Classification of irregularities, convenient, - - - - -	46
anterior protrusion of upper front teeth, - - - - -	91	Classification of odontomes, - - -	312
exciting necrosis of the jaws, -	377	Closure of the jaws, - - - - -	346
fracture of the lower jaw, - - -	364	Cohesive cavities, starting, - - - -	194
giving rise to abnormalities of permanent teeth, - - - - -	40	Coleman, Mr., on case of dentition, process of eruption, - - - - -	4
honeycombed teeth, - - - - -	109	Colloid degeneration of the pulp, -	222
Causes, local, effecting alterations in structure and form of the teeth, - - - - -	111	Combination of methods of filling, -	203
Causes, local, of abnormalities of permanent teeth, - - - - -	42	Complications and difficulties of extraction, - - - - -	342
neuralgia, - - - - -	360	Complications arising from fracture of lower jaw, - - - - -	366
odontalgia, - - - - -	357	Complications through epileptiform convulsions, - - - - -	348
Caush, Mr., on exostosed teeth, -	260	hæmophilia, - - - - -	348
Cavities, approximal, - - - - -	197	Complications through hæmorrhage, - - - - -	348
crown, - - - - -	194	recurrent or reactionary, - - -	349
Cavities, preparation of, - - - - -	170	treatment of, - - - - -	349
for amalgam, Dr. Dodge on, - - -	178	Complications through hysteria, pain following tooth extraction, - - - - -	352
gold fillings, - - - - -	171	treatment of, - - - - -	352
plastic fillings, - - - - -	177	syncope, - - - - -	348
in general, - - - - -	170	tetanus, - - - - -	348
Cavities, starting cohesive, - - - -	194	uterine pain, - - - - -	348
Cementomata, - - - - -	314, 318	Compound follicular odontomes, -	318
Cementosis, dental, - - - - -	256	Composite odontomes, - - - - -	322
Cementum, partial necrosis of the, -	264	Concussion of teeth, - - - - -	129
Central incisors, separation of the, slight overlapping of the lateral or, - - - - -	69	causes of, - - - - -	129
Central or cerebral referred odontalgia, - - - - -	359		

	PAGE		PAGE
Concussion of teeth, treatment of, - - - - -	130	Dental pulp, disease of normal dental pulp, - - - - -	217
Condyle, hypertrophy of the, - - - - -	389	treatment of, - - - - -	235
treatment of, - - - - -	390	Dental pulp, fatty degeneration of the, - - - - -	223
Conjunctivitis, - - - - -	398	treatment of normal, - - - - -	215
Constitutional diatheses, development and eruption of teeth affected by, - - - - -	8	Dentigerous cyst, - - - - -	315, 405, 406
Contracted arch, causes of, - - - - -	37	Dentinal tumours, - - - - -	232
Contours, approximal, - - - - -	200	Dentine, absorption of, - - - - -	234
Convenient classification of irregularities, - - - - -	46	of repair, - - - - -	232
Convulsions, epileptical, complications, - - - - -	348	secondary, - - - - -	231
Morris, J. Lewis, on, - - - - -	8	treatment of sensitive, - - - - -	180
Convulsive seizures, epilepsy, - - - - -	394	Dentition, - - - - -	2
Crowding of anterior teeth, - - - - -	80, 86	abnormal, - - - - -	27
treatment of irregularities due to, - - - - -	83	abnormalities of first, - - - - -	9
Crown cavities, - - - - -	194	Dentition disturbances supposed to be caused by, - - - - -	5
Cusps, abnormalities in, - - - - -	119	treatment of, - - - - -	6
Cylinder gold for filling, - - - - -	203	Dentition, first, - - - - -	1
Cyst, dental, - - - - -	405	normal, - - - - -	22
dentigerous, - - - - -	315, 405	second, - - - - -	22
multilocular epithelial, - - - - -	406	Development and eruption of teeth affected by several constitutional diatheses, - - - - -	8
of independent formation, - - - - -	406	Development of jaw arrested, - - - - -	82
Cystic epithelial tumours, multilocular, - - - - -	314	Deviations from the normal type, - - - - -	127
Cysts connected with roots, - - - - -	269	Devitalisation of the nerve, - - - - -	236
Dr. Baker on, - - - - -	270	Diagnosis of, alveolar abscesses, - - - - -	267
treatment of, - - - - -	271	caries, - - - - -	151
Dall, Mr., on porcelain inlays, - - - - -	213	chronic rheumatoid arthritis, - - - - -	390
Dam, rubber, - - - - -	160	erosion, - - - - -	281
application of, - - - - -	162, 165	hyperæmia, - - - - -	268
Dates at which germs of teeth are formed, - - - - -	1	lead poisoning, - - - - -	304
of eruption of permanent teeth, - - - - -	25	necrosis of the jaw, - - - - -	378
Decalcification, - - - - -	147	suppuration in the antrum, - - - - -	384
Decay, arrested, - - - - -	149	swellings about the jaws, - - - - -	403
Decay, artificial, - - - - -	143	syphilitic teeth, - - - - -	103
Magitot on, - - - - -	143	systemic or general referred odontalgia, - - - - -	360
Miller on, - - - - -	143	the presence of a foreign body in the bronchus, - - - - -	354
Decay of enamel, - - - - -	135	Diatheses, development and eruption of teeth affected by several constitutional, - - - - -	8
Deficiency in number of permanent teeth, - - - - -	37	Difficulties and complications of extracting teeth, - - - - -	342
Deformities caused by cicatrices, - - - - -	46	connected with the teeth themselves, - - - - -	342
Degeneration of the pulp, calcareous, - - - - -	228	connected with the jaw, - - - - -	344
colloid, - - - - -	222	connected with the soft parts, - - - - -	346
fibroid, Mr. Hopewell Smith on, - - - - -	223	connected with certain reflex actions and diatheses, - - - - -	348
fatty, - - - - -	223	Dilacerated teeth, - - - - -	71
Dental cyst, - - - - -	405, 406	Dilaceration, - - - - -	116
exostosis, - - - - -	256	Direct cause of caries, - - - - -	146
nerve, injury of inferior, - - - - -	347	Direction of roots, abnormalities in, - - - - -	119
periosteum, diseases of the, - - - - -	250	Diseased teeth, diseases due to the presence of, - - - - -	393

	PAGE		PAGE
Diseases due to the presence of diseased teeth, - - -	393	Epithelioma of the gums, - - -	303
Diseases of dental pulp, - - -	217	treatment of, - - -	303
treatment of, - - -	235	Epitheliomatous ulcerations of the tongue, - - -	400
Diseases of the dental periosteum, gums and mucous membrane, - - -	250	causes of, - - -	400
temporary teeth, - - -	16	treatment of, - - -	401
Dislocation of teeth, - - -	130	Erosion, - - -	277
causes of, - - -	130	cause of, - - -	280
treatment of, - - -	130	diagnosis of, - - -	281
Dislocation of the jaw, - - -	375	Dr. Black on, - - -	281
bilateral, - - -	376	microscopic appearance of, - - -	280
symptoms of, - - -	376	Mr. Sutton on, - - -	281
treatment of, - - -	377	treatment of, - - -	282
unilateral, - - -	376	Eruption, food of child during, - - -	8
Disturbances, general, accompanying eruption of permanent teeth, - - -	30	herpetic, - - -	396
local, - - -	28	of individual teeth retarded, - - -	27
of nutrition, abnormalities caused by, - - -	103, 106	of permanent teeth, date of, - - -	25
supposed to be caused by detention, - - -	5	of permanent teeth, general disturbances accompanying, - - -	30
Dodge, Dr., on preparation of cavities for amalgam, - - -	178	of permanent teeth, local disturbances accompanying, - - -	28
Drill, causes of accidents in using nerve canal, - - -	241	Eruption of teeth, acute inflammation during, - - -	4
Dyspeptic ulcerations of the tongue, - - -	400	affected by several constitutional diatheses, - - -	8
treatment of, - - -	400	normal signs of approaching, - - -	2
Early extraction of deciduous teeth, cause of abnormalities, - - -	42	theories on the process of, - - -	10
Edge to edge bite, - - -	14, 96	Eruption of wisdom teeth, - - -	83
Ejector, saliva, - - -	159	Eve, Mr., on actinomycosis, - - -	304
Elastic bands, - - -	61	Exanthemata, - - -	41
Electric mallet for filling, - - -	190	Exanthematous fevers, - - -	4
description of the use of, - - -	191	alterations caused by, - - -	103, 106
Empyæma of the antrum, - - -	383	treatment of, - - -	5
diagnosis of, - - -	384	Exanthematous necrosis, - - -	381
symptoms of, - - -	383	symptoms of, - - -	382
treatment of, - - -	385	Excess in number of permanent teeth, - - -	32
Enamel nodules, - - -	117	Excision of caries, - - -	154
Wedl on, - - -	119	Exclusion of saliva before filling, - - -	155
Enamel organ, aberrations of the, secondary decay of, - - -	313	Exostosed teeth, Mr. Caush on, - - -	260
- - -	135	Exostosis, - - -	405
Enchondroma, - - -	404, 406	microscopical appearance of, - - -	257
Engine mallet for filling, - - -	190	symptoms of, - - -	261
Epilepsy, - - -	30, 394	treatment of, - - -	261
Epileptiform convulsions, complications through, - - -	348	Exostosis of the zygomatic arch, - - -	389
Epiphora, - - -	403	treatment of, - - -	290
Epithelial odontome, calcified, - - -	314	Extensive laceration of the gums, - - -	346
Epithelial odontomes, - - -	313	Extracting temporary teeth, operation of, - - -	20
treatment of, - - -	323	Extraction, early, of deciduous teeth cause of abnormalities, - - -	43
Epithelial tumours, multilocular cystic, - - -	314, 406	Extraction of individual teeth and stumps, - - -	335
Epithelioma, - - -	349, 405	Extraction of stumps, - - -	339
		by anæsthetics, - - -	340
		Extraction of teeth, complications and difficulties of, - - -	342
		Extraction of teeth in general, - - -	330

	PAGE		PAGE
Extraction of teeth, position of patient and operator during, -	330	Follicular ulceration of the gums, treatment of, -	294 295
symmetrical, -	55	Food of child during eruption of teeth, -	8
Facial paralysis, -	395	Forcing a tooth into the antrum, -	345
Failure or loss of the power of accommodation, -	397	Forcing out a tooth with the prop, -	353
Fangs of temporary teeth, theories on the absorption of, -	22	Foreign body in the bronchus, the presence of a, diagnosis of, -	354
Fatty degeneration on dental pulp, -	223	Foreign body, passage of a, through the isthmus of the fauces, -	353
Fevers, exanthemata, alterations caused by, -	103, 106	treatment of, -	353
Fibroid degeneration of the pulp, Mr. Hopewell Smith on, -	223	Form or structure of permanent teeth, abnormalities in, -	103
Fibroma, -	299, 404, 405, 406	Fracture of teeth, -	131
microscopic appearance of, -	300	causes of, -	131
treatment of, -	299	transverse, -	132
Fibrous ankylosis, osseous, -	389	treatment of, -	131
treatment of, -	391	Fracture of the jaws, -	343, 344, 364
Fibrous odontomes, -	316	lower, -	364
Filling, -	155	complications arising from, -	366
combination of methods of, -	205	Mr. Cattlin on, -	345
exclusion of saliva, -	155	Mr. Salter on, -	345
introduction of the various materials for, -	189	treatment of, -	367
glass inlays for, -	214	upper jaw, -	375
methods of separating teeth for, -	167	Frænum of the lip, -	44, 69
Fillings, porcelain inlays for, -	212	Front teeth, anterior protrusion of upper, -	91
Mr. Dall on, -	213	Gemination, -	16
Fillings, preparation of cavities for gold, -	171	General causes of caries, -	155
plastic, -	177, 208	disturbances accompanying eruption of permanent teeth, -	30
Fillings, relative value of materials used for, -	181	extraction of teeth, -	330
copper, -	183	General or systemic referred odontalgia, -	360
gold, -	182	diagnosis of, -	360
palladium, -	184	General paralysis, -	396
plastic amalgam, -	183	General periodontitis, -	256
platinum, -	184	symptoms of, -	256
tin, -	183	treatment of, -	256
treatment of sensitive dentine before, -	180	General preparation of cavities, -	170
use of matrices as an adjunct for, -	181	principles involved in treatment of irregularities, -	47
First dentition, -	1	Germ, aberrations of the whole tooth, -	323
abnormalities of, -	9	Germs of teeth are formed, dates at which, -	1
First permanent teeth, -	100	Glands, chronic or acute inflammation of the lymphatic, -	396
Fixed apparatus in regulating, the use of, -	56	Glass inlay for filling, -	214
Flagg, Dr., on amalgam for filling, -	208	Glaucoma, -	398
Fletcher, Messrs. Langley and, on saliva, -	307	Glossitis chronic superficial, -	399
Follicle, aberrations of the, -	314	Gold and amalgam for filling, -	207
Follicular odontomes, -	315	osteoplastics for filling, -	208
compound, -	318	platinum for filling, -	207
Follicular odontomes, compound, treatment of, -	323	tin for filling, -	206
		Gold filling, -	182
		preparation of cavities for, -	171

	PAGE		PAGE
Gold used for filling, cylinder, -	203	Incisors, irregularity of the lateral,	70
sheet, - - - - -	202	treatment by Mr. Charles	
tape and pellets, - - - - -	192, 202	Tomes, - - - - -	70
Gout, cause of alteration in teeth,	111	irregularity of the lower, - - -	72
Gum, acute inflammation of the,	290	Incisors, rotation of the, - - -	68
treatment of simple, - - - - -	290	separation of the central, - - -	69
treatment of mercurial, - - - - -	290	slight overlapping of the cen-	
Gum, chronic inflammation of the,	291	tral or lateral, - - - - -	70
treatment of, - - - - -	292	Inclined planes in regulating, - -	60
Gum, diseases of the, and mucous		Individual teeth, irregularities in	
membrane, - - - - -	286	position of, - - - - -	67
Gum, epithelioma of the, - - - - -	303	retarded eruption of, - - - - -	27
treatment of, - - - - -	303	and stumps, extraction of, - - -	330
Gum, follicular ulceration of the,	194	Infantum, odontitis, - - - - -	4
treatment of, - - - - -	295	treatment of, - - - - -	5
Gum, hypertrophy of the, - - - - -	286	Infective sequelæ, complications	
treatment of, - - - - -	289	through septic and, - - - - -	353
Gum, laceration of the, - - - - -	346	Inferior dental nerve, injury to the	347
Gum, polypus of the, - - - - -	298	Inflammation and ulceration,	
microscopic appearance of the,	298	syphilitic, - - - - -	297
treatment of, - - - - -	298	treatment of, - - - - -	298
Gunning splint, - - - - -	372	Injuries of the teeth, - - - - -	129
Hæmophilia, - - - - -	348	Injury to the inferior dental	
Hæmorrhage, complications		nerve, - - - - -	347
through, - - - - -	348	Inlay, glass, for filling, - - - - -	214
Hæmorrhage, recurrent or reac-		Inlay, porcelain, for filling, - - -	212
tionary, - - - - -	349	Mr. Dall on - - - - -	213
treatment of, - - - - -	349	Innocent solid tumours, - - - - -	404
Hammond splint, - - - - -	368	Inostosis, - - - - -	260
Hand mallet for filling, - - - - -	189	Interference with the movements	
Hayward or Kingsley's splint, - - -	372	of the temporo-mandibular arti-	
Hemiatrophy, case of, - - - - -	42	culation, - - - - -	387
Hemicrania, - - - - -	30	Introduction of filling materials, -	189
Hemiplegia, - - - - -	396	cohesive method, - - - - -	189
Hereditary syphilis, cause of ab-		Iodoform and wax for filling	
normalities, - - - - -	41	root canals, - - - - -	243
Heredity, cause of abnormalities, 40, 50		Irregularities, convenient classifi-	
Hern, Mr. William, on gemina-		cation of, - - - - -	46
tion, - - - - -	16	general principles involved in	
Hern's splint, - - - - -	372	treatment of, - - - - -	47
Herpetic eruptions, - - - - -	396	treatment of, due to crowding,	93
Honeycombed teeth, - - - - -	105, 106, 109	in position of individual teeth,	67
causes of, - - - - -	109	in position of upper incisors,	67
Howship's lacunæ, - - - - -	22, 25, 260, 263	of the bicuspid, - - - - -	70
Hunter, Dr. John, on urethritis, - 8, 10		of the canine, - - - - -	70
Hyperæmia, - - - - -	217	of the lower canines, - - - - -	76
treatment of, - - - - -	236	of the incisors, - - - - -	72
Hypertrophy of the condyle, - - - - -	389	of the molars, - - - - -	79
treatment of, - - - - -	390	of the molars, Salter on, - - - -	79
Hypertrophy of the gums, - - - - -	286	Irregularity of the lateral incisor,	70
treatment of, - - - - -	289	Jack screw, - - - - -	57, 58
Hysteria, - - - - -	395	Jaw, arrested development of, - - -	82
complications through, - - - - -	348	closure of the, - - - - -	346
Implantation of teeth, - - - - -	325, 327	Jaw, dislocation of the, - - - - -	375
Incisors, irregularities in position		lower, - - - - -	375
of the upper, - - - - -	67	Jaw, fracture of the, - - - - -	343, 344
		Mr. Cattlin on, - - - - -	345

	PAGE		PAGE
Jaw, Mr. Salter on, - - -	344	Local disturbances accompanying eruption of permanent teeth, -	28
Jaw, fracture of the lower, -	364	Local odontalgia, - - -	357
complications arising from, -	366	acute, - - -	357
treatment of, - - -	367	treatment of, - - -	358
Jaw, fracture of the upper, -	375	chronic, - - -	358
Jaw, lower, swellings involving the, - - -	106	Local periodontitis, acute, - - -	250
Jaw, necrosis of the, - - -	378	treatment of, - - -	252
diagnosis of, - - -	378	Local periodontitis, chronic, - - -	254
exciting causes of, - - -	378	diagnosis of, - - -	255
treatment of, - - -	378	treatment of, - - -	255
Jaw, protrusion of the lower, -	13	Loss or failure of the power of accommodation, - - -	396
Dr. Kingsley on, - - -	13	Lower canines, irregularities of the, - - -	76
Dr. Talbot on, - - -	13	Lower incisors, irregularities of the	72
Jaw, stiff, - - -	387	Lower jaw, dislocation of the, -	345
causes of, - - -	387	Lower jaw, fracture of the, -	364
treatment of, - - -	390	causes of, - - -	364
Jaw, swellings about the, diagnosis of, - - -	403	complications arising from, -	366
Kingsley, Dr., on neurotic tendencies, - - -	40	symptoms of, - - -	365
on protrusion of the lower jaw, - - -	13	treatment of, - - -	367
Kingsley's or Hayward's splint, -	370	Lower jaw, protrusion of the, -	13
Kirby, Mr., on amalgam, - - -	185	Dr. Kingsley on, - - -	13
for filling, - - -	208	Dr. Talbot on, - - -	13
Laceration of the gum, - - -	346	swellings involving the, -	406
Lack of anterior occlusion, open bite, - - -	14, 98	Lower teeth, protrusion of the, 'underhung bite,' - - -	96
causes of, - - -	98	treatment of, - - -	96
treatment of, - - -	98	Ludovici, Angina, - - -	30
Lacunæ, Howship's, -22, 25, 260,	263	Lupoid ulceration of the tongue,	402
Lagophthalmos, - - -	398	Luxation, sub- - - -	377
Lamellar cataract, - - -	110	Lymphatic glands, chronic or acute inflammation of the, - - -	396
Langley and Fletcher, Messrs., on saliva, - - -	307	treatment of, - - -	396
Larynx, tongue slipping back over the, - - -	353	Macroscopical appearance of abnormalities in form, - - -	106
treatment of, - - -	353	Macroscopical phenomena of caries,	135
Lateral incisors, irregularity of the, treatment by Mr. Charles Tomes, - - -	70	Magitot, Mr., on artificially produced caries, - - -	143
Lateral incisors, slight overlapping of the central or, - - -	70	Malignant tumours, treatment of deep seated, - - -	390
Lead poisoning, - - -	303	Mallets, automatic, - - -	189
diagnosis of, - - -	304	electric, - - -	190
treatment of, - - -	304	engine, - - -	190
Lewis, Morris J., on convulsions,	6	hand, - - -	189
Ligament, ossification of the pterygo-maxillary, - - -	389	pneumatic, - - -	190
treatment of, - - -	390	Mandibular nerve, injury to, -	347
Lip, frænum of the, - - -	44, 69	Materials, introduction of filling, cohesive method, - - -	189
Lips, bruising the, - - -	347	Materials used for canal filling, -	242
Local causes effecting alterations in the structure and form of the teeth, - - -	111	gold and copper wire, - - -	243
		gutta percha, - - -	242
		wood, - - -	243
		iodoform and wax, - - -	243
		Materials used for filling teeth, relative value, - - -	181

	PAGE		PAGE
Matheson, Mr., on use of amadou, - - -	159	Nerve mandibular, - - -	347
Matrices, use of, - - -	181, 210	Nerve, removal of the, - - -	239
Membrane, Naysmith's, - - -	136	treatment when dead, - - -	245
Mercury, abnormalities caused by		Neuralgia, - - -	30, 356, 360, 396
the use of, - - -	103, 106	symptoms of, - - -	361
Method of filling, non-cohesive, -	202	treatment of, - - -	362
rope gold, - - -	203	Neurotic tendencies, Dr. Kingsley	
sheet gold, - - -	202	on, - - -	40
stars or stripes of gold, -	203	Nodules, enamel, - - -	117
tape gold, - - -	202	Wedl on, - - -	119
Methods of filling, combination of,	205	Noma, - - -	296
Methods of introducing filling		treatment of, - - -	297
material, cohesive, - - -	189	Non-cohesive method of filling, -	202
punching holes in rubber, -	160	non-infected zone, - - -	140
separating teeth, - - -	167	Normal dental pulp, treatment of,	215
using electric mallet, - - -	191	Normal dentition, - - -	22
Micro-organisms, - - -	149	signs of approaching eruption	
Microscopical appearance of abnor-		of teeth, - - -	2
malities in form, - - -	108	type, deviations from the, -	127
absorption, - - -	263	Number of permanent teeth, ab-	
attrition, - - -	282	normalities in, - - -	32
caries, - - -	138	deficiency in, - - -	37
erosion, - - -	280	excess in, - - -	32
exostosis, - - -	257	Number of temporary teeth, ab-	
fibroma, - - -	300	normalities in, - - -	12
hypertrophy of the gum, -	287	teeth comprising temporary	
polypus of the gum, - - -	298	set, - - -	3
Miller, Mr., on artificially pro-		Nutrition, abnormalities caused	
duced caries, - - -	143	by disturbances of, - - -	103, 106
Molar, first permanent, - - -	100	Oblique rooted teeth, - - -	123
irregularities of, - - -	79	Occlusion, lack of anterior, 'open	
Salter on, - - -	79	bite,' - - -	14, 98
Mortality through teething, -	3	causes of, - - -	98
Mouth-prop, - - -	341	treatment of, - - -	98
Mucous membrane, diseases of the		Odontalgia, - - -	30, 356
gum and, - - -	286	Odontalgia, acute, local, - - -	357
Multilocular cystic epithelial		treatment of, - - -	358
tumours, - - -	314, 406	Odontalgia, causes of, - - -	357
Mydriasis, - - -	397	chronic, local, - - -	358
Myeloid sarcoma, - - -	301	Odontalgia, referred, - - -	358
treatment of, - - -	301	cerebral or central, - - -	358
Myxoma, - - -	404	diagnosis of, - - -	360
Naysmith's membrane, - - -	136	peripheral, - - -	358
Necrosis, - - -	264	systemic or general, - - -	360
exanthematous, - - -	381	Odontitis infantum, - - -	4
symptoms of, - - -	382	treatment of, - - -	5
of the cementum, partial, -	264	Odontomes, - - -	312
Necrosis of the jaws, - - -	378	classification of, - - -	312
diagnosis of, - - -	378	treatment of, - - -	323
exciting cause of, - - -	378	Odontomes, compound follicular,	318
treatment of, - - -	378	symptoms of, - - -	322
Necrosis, phosphorus, - - -	380	treatment of, - - -	322
symptoms of, - - -	381	Odontomes, composite, - - -	322
Neighbouring tooth, accidental		epithelial, - - -	312
removal of, - - -	343	epithelial, calcified, - - -	314
Nerve, devitalisation of the, -	236	fibrous, - - -	316
injury to the, - - -	347	follicular, - - -	315

	PAGE		PAGE
Odontomes, radicular, - - -	321	Periodontitis, treatment of, -	256
Open bite, - - - - -	14, 98	Periosteum, diseases of the dental,	250
Operation of extracting temporary teeth, - - - - -	20	Periostitis, dental, - - - - -	250
Operator, position of, during extraction of teeth, - - - - -	330	Permanent molar, first, - - - - -	100
Orbicularis palpebrarum, spasm of the, - - - - -	398	Permanent teeth, abnormalities of, -	31
Organ, aberrations of the enamel,	313	causes giving rise to, - - - - -	40
Oris, cancrum, - - - - -	296	deficiency in number, - - - - -	37
prognosis of, - - - - -	297	excess in number, - - - - -	32
treatment of, - - - - -	297	position, - - - - -	39
Osseous or fibrous ankylosis, -	389	size, - - - - -	31
treatment of, - - - - -	391	structure or form, - - - - -	103
Ossification of the pterygo-maxillary ligament, - - - - -	389	Permanent teeth, dates of eruption of, - - - - -	25
treatment of, - - - - -	390	general disturbance accompanying eruption of, -	30
Osteodentine, - - - - -	234	local disturbance accompanying eruption of, -	30
Osteoma, - - - - -	404	Persistence of temporary teeth, undue, cause of abnormalities, -	42
Osteoplastics, - - - - -	186, 211	Phenomena, macroscopical, of	
and gold for filling, - - - - -	208	caries, - - - - -	135
and amalgam for filling, -	210	Phosphorus necrosis, - - - - -	380
Otalgia, - - - - -	30, 396	symptoms of, - - - - -	381
Otorrhœa, - - - - -	396	Pianoforte wire for dental use, -	61
Overlapping of the central or lateral incisors, slight, - - -	70	Pigmentation in caries, - - - - -	137
Owen, Prof., on Mr. Coleman's theory of eruption, - - - - -	10	Planes, inclined, - - - - -	60
Pain following tooth extraction, complications through, - - - - -	352	Plasters, capsicum, - - - - -	253
treatment of, - - - - -	352	Plates, retention, - - - - -	66
Palate, swellings in the, - - -	405	Platinum filling, - - - - -	184
Palladium, filling, - - - - -	184	and gold for filling, - - - - -	207
Palpebrarum, spasm of the orbicularis, - - - - -	398	Pneumatic mallet for filling, -	190
Paper, bibulous, - - - - -	158	Poisoning, lead, - - - - -	303
Papilla, aberrations of the - -	321	diagnosis of, - - - - -	304
Papilloma of the gums, - - - -	301	treatment of, - - - - -	304
treatment of, - - - - -	301	Polypus of the gum, - - - - -	298
Paralysis, - - - - -	30	microscopic appearance of, -	298
facial, - - - - -	395	treatment of, - - - - -	298
general, - - - - -	396	Porcelain, inlays for filling, -	212
Paraplegia, - - - - -	396	Mr. Dall on, - - - - -	213
Partial necrosis of the cementum,	264	Position of individual teeth, irregularities in, - - - - -	67
Passage of a foreign body through the isthmus of the fauces, -	353	operator and patient during extraction, - - - - -	350
treatment of, - - - - -	353	permanent teeth, abnormalities in, - - - - -	39
Patient during extraction, position of, - - - - -	330	temporary teeth, abnormalities in, - - - - -	12
Pericementitis, - - - - -	250	upper incisors, irregularities of, - - - - -	67
Periodontitis, acute, local, - -	250	Power of accommodation, loss or failure of the, - - - - -	397
treatment of, - - - - -	252	Predisposing causes of caries, -	144
Periodontitis, chronic, local, -	254	Preparation of cavities in general,	170
diagnosis of, - - - - -	255	for amalgam, Dr. Dodge on, -	178
treatment of, - - - - -	255	for gold filling, - - - - -	171
Periodontitis, general, - - - -	256	for plastic filling, - - - - -	177
symptoms of, - - - - -	256	Preparation of the root canals for filling, - - - - -	240

	PAGE		PAGE
Principles involved in treatment of irregularities, general, - -	47	Removal of molars, - - -	85
Process of eruption, theories on the, - - -	10	Removal of neighbouring tooth, accidental, - - -	343
Prop, forcing out a tooth with the, - - -	353	the nerve, - - -	239
mouth, - - -	341	the wrong tooth, - - -	343
Protrusion of the lower jaw, -	13	Replantation of teeth, - - -	325
Dr. Kingsley on, - - -	13	Resistance of the tooth and alveolus during extraction, - - -	342
Dr. Talbot on, - - -	13	Retarding of eruption of individual teeth, - - -	27
Protrusion of the lower teeth, 'underhung bite,' - - -	96	Retention plates, - - -	66
treatment of, - - -	96	Reticular atrophy of pulp, - - -	223
Protrusion of upper front teeth, anterior, - - -	91	Retzius, brown striæ of, - - -	108
Pterygo-maxillary ligament, ossification of the, - - -	389	Rheumatoid arthritis, chronic, -	388
treatment of, - - -	390	Rhizodontrophy, - - -	18, 247, 268
Ptosis, - - -	397	Rickets, affecting teeth, - - -	106
Ptyalin, - - -	306	cause of abnormalities, - - -	40
Pulp, calcification of the tissues of the, - - -	229	treatment of, - - -	90
degeneration of the, - - -	228	Rodent ulcerations of the tongue, -	402
Pulp, diseases of dental, - - -	217	Root canals for fillings, preparation of the, - - -	240
treatment of, - - -	217	oblique, - - -	123
Pulp, hypertrophy of the, - - -	220	Roots, abnormalities in, - - -	119
normal dental, treatment of, -	215	direction of, - - -	119
reticular atrophy of, - - -	223	Rope gold, for filling, - - -	203
when exposed by traumatism, treatment of, - - -	215	Rotation of canines, - - -	75
Pulp, when not exposed, treatment of, - - -	215	incisors, - - -	68
Punching holes in rubber dam, -	160	Rubber-dam, - - -	160
Purpura, - - -	293	Sachs, Dr., on chorea, - - -	30
treatment of, - - -	293	Saddle-shaped arch, - - -	89
Pyorrhœa alveolaris, - - -	271	treatment of, - - -	89
ætiology of, - - -	273	Saliva, - - -	306
treatment of, - - -	275	ejector, - - -	159
Rachitis or rickets affecting teeth, -	106	exclusion of, during filling, -	155
cause of abnormalities, - - -	41	Messrs. Langley & Fletcher on, -	307
treatment of, - - -	90	uses of, - - -	307
Radicular odontomes, - - -	321	Salivary calculus or tartar, - - -	308
Ranine artery, wound of the, -	347	causes of, - - -	309
treatment of, - - -	347	treatment of, - - -	310, 311
Ranula, - - -	305	Salter, Mr., on fracture of the jaws, -	344
cause of, - - -	305	on their irregularities of molars, -	79
treatment of, - - -	321	Sapræmia, - - -	267
Reactionary or recurrent hæmorrhage, complications through, -	349	Screw, Jack, - - -	57, 58
treatment of, - - -	349	Scurvy, - - -	292
Referred odontalgia, - - -	358	treatment of, - - -	292
central or cerebral, - - -	358, 359	Secondary dentine, - - -	231
peripheral, - - -	358, 359	dentition, - - -	22
Referred odontalgia, systemic or general, - - -	358, 360	enamel decay, - - -	135
diagnosis of, - - -	360	Seizures, epilepsy, and convulsive, -	394
Relative value of materials used for filling teeth, - - -	181	Sensitive dentine, treatment of, -	180
		Separating teeth, methods of, -	169, 170
		Separation of the central incisors, -	69
		Separators, - - -	169, 170
		Septic and infective sequelæ, complications through, - - -	353
		Sequelæ, complications through septic and infective, - - -	353

	PAGE		PAGE
Severe neuralgia, - - - -	396	Swellings involving the lower jaw, -	406
Sheet, gold, for filling, - -	202	Symmetrical extraction, - - - -	55
Signs of approaching eruption of teeth, normal, - - - -	2	Symptoms of alveolar abscesses, -	261
Simple irritable ulcers of the tongue, - - - -	400	caries and diagnosis, - - - -	150
treatment of, - - - -	400	Symptoms of dislocation, bilateral, -	376
Size of permanent teeth, abnor- malities in, - - - -	31	treatment of, - - - -	377
teeth, unusual development in, -	83	Symptoms of dislocation, unilateral, -	376
temporary teeth, abnormali- ties in, - - - -	11	treatment of, - - - -	377
Slight overlapping of the central or lateral incisors, - - - -	70	Symptoms of exostosis, - - - -	261
Smith, Mr. Hopewell, on fibroid degeneration of the pulp, - -	223	fracture of lower jaw, - - - -	365
Solid innocent tumours, - - - -	404	neuralgia, - - - -	361
Sordes, - - - -	307	necrosis, exanthematous, - -	382
Spasm of the orbicularis palpe- brarum, - - - -	396	necrosis, phosphorus, - - - -	381
Splint, choice of a, - - - -	373	odontomes, - - - -	322
Splints for fractured jaws, - - -	368	suppuration in the antrum, -	384
Gunning's, - - - -	372	Syncope, complications through, -	348
Hammond's, - - - -	368	Syphilis, hereditary, cause of ab- normalities, - - - -	41, 102
Hayward's or Kingsley's, - -	370	Syphilitic inflammation and ulceration, - - - -	297
Hern's, - - - -	372	treatment of, - - - -	298
Stars or stripes, gold, for filling, -	203	Syphilitic teeth, diagnosis of, -	105
Starting cohesive cavities, - - -	194	Syphilitic ulcerations of the tongue, -	401
Stiff jaw, - - - -	387	treatment of, - - - -	402
causes of, - - - -	387	Talbot, Dr., on protrusion of the lower jaw, - - - -	13
Stokes, Mr. C., clamps, - - - -	158	Tape gold for filling, - - - -	202
Stomatitis, gangrenous, - - - -	296	Tartar, - - - -	308
treatment of, - - - -	297	cause of, - - - -	309
Stomatitis, ulcerative, - - - -	295	treatment of, - - - -	310, 311
treatment of, - - - -	295	Teeth, anterior protrusion of upper front, - - - -	91
Structure or form of permanent teeth, abnormalities in, - - -	103	are formed, dates at which germs of, - - - -	1
temporary teeth, abnormali- ties in, - - - -	15	bleaching, - - - -	247
Struma, - - - -	41	calcification at different ages of the, - - - -	27
Strychnine poisoning and tetanus, -	390	crowding of anterior, - - - -	80
treatment of, - - - -	390	date of eruption of permanent, diagnosis of honeycombed, -	25
Stumps, extraction of, - - - -	330	diagnosis of syphilitic, - - -	105
Sub-luxation, - - - -	377	dilacerated, - - - -	71
Sucking of tongue, thumbs, lip, and toe, - - - -	45	eruption of wisdom, - - - -	83
Sullivan's amalgam, - - - -	102	exostosed, Mr. Caush on, - -	269
Supernumerary teeth, - - - -	44, 68	Teeth, extraction of, complica- tions and difficulties attending, -	342
Suppuration in the antrum, - - -	383	general, - - - -	330
diagnosis of, - - - -	384	individual teeth and stumps, -	335
symptoms of, - - - -	383	under anæsthetics, - - - -	340
treatment of, - - - -	385	Teeth, gout, a cause of alteration in, - - - -	111
Sutton, Mr. Bland, on excess of permanent teeth, - - - -	36	honeycombed, causes of, - -	109
Swellings about the jaws, dia- gnosis of, - - - -	403	implantation of, - - - -	325, 327
in the palate, - - - -	405	injuries of the, - - - -	129
involving the antrum, - - - -	403	irregularities in position of individual, - - - -	67
		liability to caries of, - - - -	134

	PAGE		PAGE
Teeth, local causes effecting alterations in, - - - - -	111	Theories on the absorption of fangs of temporary teeth, - - -	22
methods of separating, - - - - -	167	on the process of eruption, - - -	10
normal signs of approaching eruption of, - - - - -	2	Thrush, - - - - -	293
number comprising temporary set of, - - - - -	3	Thumb, lip, tongue and toe sucking, - - - - -	45
Teeth, permanent, abnormalities of, - - - - -	29	Tin for filling, - - - - -	183, 208
in number, - - - - -	32	and gold for filling, - - - - -	206
in position, - - - - -	39	Tissues of the pulp, calcification of the, - - - - -	229
in size, - - - - -	29	of which a tooth is composed, various, - - - - -	1
in structure or form, - - - - -	103	Tomes, Mr. Charles, on treatment of irregularities of lateral incisors, - - - - -	70
causes giving rise to abnormalities in, - - - - -	40	Tongue, affections of the, met with in dental practice, - - - - -	399
deficiency in number of, - - - - -	37	slipping back over the larynx, - - - - -	353
excess in number of, - - - - -	32	treatment of, - - - - -	353
general disturbances attending eruption of, - - - - -	29	ulcers of the, - - - - -	400
local disturbances attending eruption of, - - - - -	28	dyspeptic ulceration of the, - - -	400
Teeth, protrusion of the lower, 'underhung bite,' - - - - -	96	treatment of, - - - - -	400
relating to eruption of individual, - - - - -	27	epitheliomatous ulceration of the, - - - - -	400
replantation of, - - - - -	325	causes of, - - - - -	400
supernumerary, - - - - -	44, 68	treatment of, - - - - -	401
temporary, abnormalities of, - - -	11	rodent and lupoid ulceration of the, - - - - -	402
in size, - - - - -	11	simple irritable ulceration of the, - - - - -	400
temporary, caries in, - - - - -	17	treatment of, - - - - -	400
temporary, diseases in, - - - - -	16	syphilitic ulcerations of the, - - -	401
undue persistence of temporary, cause of abnormalities, - - -	42	treatment of, - - - - -	402
unusual development in size of, - - - - -	83	tubercular ulcerations of the, - - -	402
Teething, mortality through, - - - - -	3	treatment of, - - - - -	402
Temporary set of teeth, number comprising a, - - - - -	3	wounding the mouth or, - - - - -	346
Temporary teeth, abnormalities of the, - - - - -	11	treatment of, - - - - -	347
in size, - - - - -	11	Tooth extraction, complications through pain following, - - - - -	352
caries in the, - - - - -	17	treatment of, - - - - -	352
treatment of, - - - - -	17	forced out by prop, - - - - -	353
diseases of the, - - - - -	16	Torsion of teeth, - - - - -	69, 75
operation of extracting, - - - - -	20	Translucent zone, - - - - -	137
theories on the absorption of fangs of, - - - - -	22	Transparency through caries, - - - - -	136
undue persistence of, a cause of abnormalities, - - - - -	42	Transplanting of teeth, - - - - -	325, 326
Temporo-mandibular articulation, interference with the movements of the, - - - - -	387	Transposition, - - - - -	70, 75, 78
Tendencies, neurotic, Dr. Kingsley on, - - - - -	40	Transverse fracture of teeth, - - - - -	132
Tetanus and strychnine poisoning, treatment of, - - - - -	390	Treatment of abrasion, - - - - -	285
Tetanus, complications through, - - -	348	abscesses, - - - - -	268, 271
Theories of cause of caries, - - - - -	148	acute inflammation during eruption, - - - - -	5
		acute, local odontalgia, - - - - -	358
		acute, local periodontitis, - - - - -	252
		alveolar abscesses, - - - - -	268, 275
		anterior protrusion of upper front teeth, - - - - -	93
		attrition, - - - - -	284

	PAGE		PAGE
Treatment by Mr. Charles Tomes		Treatment of pain following tooth	
of irregularities of lateral in-		extraction, - - - - -	352
cisors, - - - - -	70	papilloma of the gum, - - -	301
cancerum oris, - - - - -	297	polypus of the gum, - - -	298
caries, - - - - - 151,	154	protrusion of the lower teeth,	
caries in temporary teeth, -	17	'underhung bite,' - - -	96
chronic odontalgia, - - -	358	purpura, - - - - -	293
chronic periodontitis, - - -	255	pyorrhœa alveolaris, - - -	275
chronic rheumatoid arthritis,	391	rachitis or rickets, - - -	9
cicatricial bands, - - - -	390	ranula, - - - - -	305
concussion of teeth, - - -	129	recurrent or reactionary	
crowding of anterior teeth, -	83	hæmorrhage, - - - - -	349
cysts, - - - - -	271	salivary calculus, - - - 310,	311
diseases of normal dental		scurvy, - - - - -	293
pulp, - - - - - 217,	235	sensitive dentine, - - - -	180
dislocation of the jaw, - - -	377	suppuration in the antrum, -	385
dislocation of teeth, - - -	130	syphilitic inflammation and	
disturbances supposed to be		ulceration, - - - - -	298
caused by dentition, - - -	6	tetanus and strychnine	
emphyæmia of the antrum, - -	385	poisoning, - - - - -	390
epithelioma of the gums, - -	303	the protrusion of the lower	
erosion, - - - - -	282	teeth, - - - - -	96
exanthematous fevers during		thrush, - - - - -	294
eruption, - - - - -	5	tongue slipping over the	
excess of permanent teeth, -	36	larynx, - - - - -	353
exostosis, - - - - -	261	trismus, - - - - -	387
exostosis of the zygomatic		tumours, 302, 314, 390, 396,	404
arch, - - - - -	390	tumours pressing upon the	
fibroma of the gum, - - - -	390	jaw from without, - - -	390
follicular ulceration of the		U-, V-, and saddle-shaped	
gums, - - - - -	295	arches, - - - - - 88,	89
fracture of teeth, - - - - -	131	ulcerative stomatitis, - - -	295
fractures of the lower jaw, -	367	ulcers of the tongue, 400, 401,	402
fractures of the upper jaw, -	375	when the nerve is dead, - -	245
gangrenous stomatitis, - - -	297	wounds of the canine, - - -	347
hypertrophy of the condyle, -	390	wounds of the tongue, - - -	347
hypertrophy of the gums, - -	289	Trismus, - - - - - 346,	387
inflammation of gums, - 290,	291	treatment of, - - - - -	387
inflammation of the lym-		Tubercular ulcers of the tongue, -	402
phatic glands, - - - - -	396	treatment of, - - - - -	402
irregularities due to crowding,	83	Tumours, deep-seated malignant,	390
irregularities in molars, - -	79	treatment of, - - - - -	405
lack of anterior occlusion, - -	98	innocent solid, - - - - -	404
lead poisoning, - - - - -	303	multilocular cystic epithelial,	314
myeloid sarcoma of the gums,	301	pressing upon the jaw from	
necrosis of the jaw, - - - -	378	without, - - - - -	390
neuralgia, - - - - -	362	treatment of, - - - - -	390
nomia, - - - - -	297	vascular, - - - - -	302
normal dental pulp, - - - -	215	treatment of, - - - - -	302
normal dental pulp when ex-		Type, deviations from the normal,	127
posed, - - - - -	215	Ulceration of the gum, follicular,	294
normal dental pulp when not		treatment of, - - - - -	295
exposed, - - - - -	215	Ulceration, syphilitic inflamma-	
odontitis infantum, - - - -	5	tion and, - - - - -	297
odontomes, - - - - - 322,	323	treatment of, - - - - -	298
osseous or fibrous ankylosis,	391	Ulceration of the tongue, dyspeptic,	400
ossification of the pterygo-		treatment of, - - - - -	400
maxillary ligament, - - -	389		

	PAGE		PAGE
Ulceration of the tongue, epitheliomatous, - - - - -	400	Use of amadou, Mr. Matheson on, - - - - -	159
causes of, - - - - -	400	fixed apparatus, - - - - -	57
treatment of, - - - - -	401	matrices, - - - - -	181, 210
Ulceration of the tongue, rodent and lupoid, - - - - -	402	mercury, abnormalities caused by, - - - - -	103, 106
Ulceration of the tongue, simple, - - - - -	400	Value of materials used for filling teeth, - - - - -	181
treatment of, - - - - -	400	Varieties of caries, - - - - -	136
Ulceration of the tongue, syphilitic, - - - - -	401	Vascular tumours, - - - - -	302
treatment of, - - - - -	402	treatment of, - - - - -	302
Ulceration of the tongue, tubercular, - - - - -	402	V-shaped arch, - - - - -	89
Ulcerative stomatitis, - - - - -	295	treatment of, - - - - -	89
treatment of, - - - - -	295	Wax and iodoform for filling root canals, - - - - -	243
Underhung bite, - - - - -	96	Wedges, - - - - -	59, 60
treatment of, - - - - -	96	Wedl on enamel nodules, - - - - -	119
Undue persistence of temporary teeth a cause of abnormalities, - - - - -	42	Wire, copper, for filling canals, - - - - -	243
Unilateral dislocation of the jaw, - - - - -	376	gold, for filling, - - - - -	66, 263
treatment of, - - - - -	377	pianoforte, for dental use, - - - - -	61
Unusual development in size of teeth, - - - - -	83	Wisdom teeth, eruption of, - - - - -	83
Upper front teeth, anterior protrusion of, - - - - -	91	Wood for filling canals, - - - - -	243
incisors, irregularities in position of, - - - - -	67	Woodhouse, Mr. Alfred, on movement of molars, - - - - -	85
Upper jaw, fracture of the - - - - -	375	Wound of the maxillary artery, - - - - -	347
treatment of, - - - - -	375	treatment of, - - - - -	347
Urethritis, Dr. John Hunter on, - - - - -	8, 10	Wound of the tongue or mouth, - - - - -	346
U-shaped arch, - - - - -	87	treatment of, - - - - -	347
treatment of, - - - - -	88	Wrong tooth, removal of the, - - - - -	343
Uterine pain, complications through, - - - - -	348	Zone, non-infected, - - - - -	140
		translucent, - - - - -	137
		Zygomatic arch, exostosis of the, - - - - -	389
		treatment of, - - - - -	390



1/2

