

Complete elements of the science and art of the dentist : followed by an historical and chronological notice of the works published on the dental art, from the time of Hippocrates : adopted for the schools of medicine and pharmacy, by ministerial ordinance, rendered upon the report of the Royal Council of Public Instruction, and for the hospitals of the ports and colonies of France, by ministerial ordinance, upon the report of the inspector general of the Marine service of health / by M. Désirabode, assisted by his sons.

Contributors

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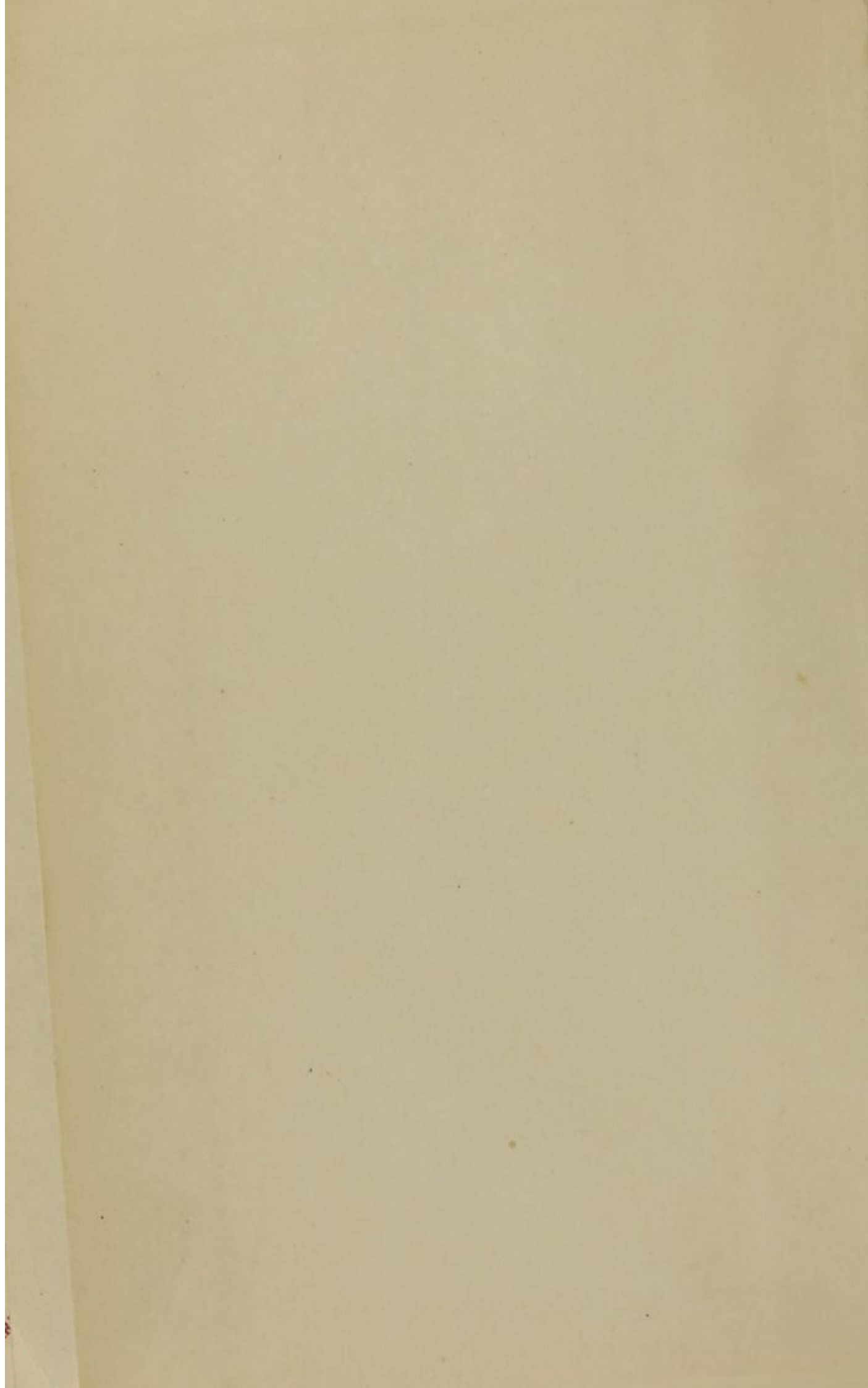


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COMPLETE ELEMENTS
OF THE
SCIENCE AND ART
OF
THE DENTIST.

BY M. DESIRABODE,

SURGEON DENTIST TO THE KING,
ASSISTED BY HIS SONS, DOCTORS OF MEDICINE.

FOLLOWED BY

An Historical and Chronological Notice of the Works published on the Dental Art,
from the time of Hippocrates.

ADOPTED FOR THE SCHOOLS OF MEDICINE AND PHARMACY, BY MINISTERIAL ORDINANCE,
RENDERED UPON THE REPORT OF THE ROYAL COUNCIL OF PUBLIC INSTRUCTION;
AND FOR THE HOSPITALS OF THE PORTS AND COLONIES OF FRANCE, BY MINISTERIAL ORDINANCE, UPON THE REPORT OF THE INSPECTOR GENERAL OF THE MARINE SERVICE OF HEALTH.

SECOND EDITION.

Translated from the French, for the American Library of Dental Science.

BY *—A.—*

25772

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PUBLISHED BY THE AMERICAN SOCIETY OF DENTAL SURGEONS.

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INTRODUCTION.

WHATEVER may be the science to the study of which we devote ourselves, we may promote our advancement and facilitate inquiry in two ways entirely different from each other.

The one consists in patiently re-examining whatever of doubtful character certain points of the science in question may involve, in submitting them to a new investigation, enlightened by the knowledge of the first causes; then to deduce from them general principles in harmony with the degree of advancement to which the other parts of our knowledge have attained, that have with them either simple analogies of origin or direct relations of the end.

The other consists in collecting all the facts that experience has positively and definitely determined, in binding the two together, and to establish upon their methodical resemblance and their reciprocal connections, principles immediately applicable to practice.

The first of these two modes, more elevated, perhaps more worthy, constitutes that which we have concluded to call philosophical study, from whence flows THEORY. The other, more modest, but not less useful, since it represents in the tree of science the branch which bears the fruit, constitutes the study of application, from which is derived art properly so called, or that which we term PRACTICE.

Medicine, whatever may be the fundamental homogeneity of the parts of which it is composed, and the firmness of the principles which serve as a base for it, can no more than the other sciences withdraw itself from this double mode of study and this division in its exercise.

Thus, although theory and practice, far from excluding each other, and progressing separately, ought, without doubt, more than any other thing, reciprocally to enlighten each other, and lend,

under all circumstances, a mutual aid ; it is no less true than strange, that among those who devote themselves to the alleviation of human suffering, there are many who, adopting their theory, as it were, ready made, occupy themselves exclusively with its application. Still more, in this already circumscribed sphere, some confine themselves to a single branch, which they make the object of an exclusive preference and the subject of a particular study.

Such are dentists, oculists, lithotomists accoucheurs, hernial surgeons, orthopedists ; all those, in a word, who devote themselves to that which we commonly name a speciality.

Is this admission of the specialities in the practice of medicine of any advantage in the progress of the art, and, therefore, as profitable to mankind as the interested parties have generally pretended, and have endeavored to make others believe.

Without wishing to examine thoroughly the value of these assertions by which each specialist seeks to justify his exceptionable position, and to make comparative advantages result from it, we think nevertheless that, if it is permissible to reply affirmatively to the question we have stated, it ought certainly to be so for dental medicine and surgery ; not certainly superior by reason of the importance we would assign to the organs which form its domain, for all the parts of the economy are to our eyes important, since they are essentially necessary for the continuance of life and the preservation of health ; but because, if it is demonstrated by daily experience that all the operations which belong to the other specialities are executed with an undoubted superiority by surgeons who occupy themselves with the general art, it is evident that dental surgery not only demands the various and complete studies which are indispensable to the practice of the other branches of medicine, but it has still more, a very distinct and imperious necessity of a knowledge of all the particulars of mechanism.

Now, this knowledge acquired only by those studies which application in no other part of their practice find, would draw away by far too much those who destine themselves to general medicine, and even simply to surgery.

Thus have there been, from time immemorial, some who oc-

cupied themselves exclusively with the diseases of the mouth, the treatment of which they specially require, and even the care very frequently necessary for the restoration of the different parts which compose it, but particularly the teeth. The writings of Herodotus and Hippocrates, among the Greeks ; of Celsus, Pliny, Martial and Horace, among the Romans, have not left, as we shall more than once be able to prove, any doubt upon this subject.

Unfortunately at this remote epoch, and even at a more recent period, dental surgery being included in that unjust disdain with which the most absurd of prejudices had stigmatised manual medicine, properly so called, was the prey of empirics, of charlatans, and even of jugglers, ignorant men, who, following the judicious remark of Theodore Zwinger, had no reputation to risk, no merit to expose, and above all, he might have been able to add, no security to offer : who would have extracted with impunity a tooth and inflicted at the same time, upon the mouth, every possible mutilation. Besides, their ignorance found its excuse in the opinion so generally spread, and which their irrational manœuvres constantly maintained, that the extraction of a tooth could not be effected without mangling the gums or at least breaking the alveolus !

It was reserved for the present age, besides being so fruitful in useful information and salutary institutions, to do away with an abuse so contrary to the dignity of the art, so little conformable to the good of mankind, and against which there were ineffectually exerted, with all the strength of their genius and the influence of their position, the efforts of Ambrose Paré, Guy de Chauliac, Vigo, Dionis, who were at that time the fathers and glory of French surgery.

The law of the 5th of March, 1802, in refusing to any one the right of exercising the art of healing, without having obtained, by public examination, the grade of doctor of medicine or the title of officer of health, has implicitly recognised, in spite of the decree of the supreme court of the 23d of February, 1827, (a decree which constitutes an omission without establishing a principle,) this law we say, has declared, that the preservation of organs so valuable as the teeth ought not to be abandoned

to the stupid and brutal ignorance of empirics, whose destructive vandalism might constantly be attended with the most serious errors, and, consequently, the most deplorable accidents.

"One of the most distinguished surgeons of our day, M. Marjolin,* whose word will always be authority when he speaks of that which relates to the good of the science and the dignity of the profession, truly says, the exercise of the art of the dentist constantly demands knowledge greatly extended and complicated. Hence it is important it should be practiced by those who have made it the exclusive object of their studies; for dentistry does not consist in a knowledge of the most evident affections of a tooth, and the performance on it of the most simple operations and the most clumsy manipulations; it is necessary to have the most accurate knowledge of the anatomy of the mouth, particularly that of the teeth, and to unite general notions of anatomy, physiology, medicine, hygiene, mechanism, and still more, the skill of the goldsmith."

In publishing a new treatise upon the Art of Dentistry, an art which no word expresses directly in our language, but which we call *odontology*, or *odontechny*, when it is confined to the study of the teeth, and *stomatomy*, when it comprehends all the parts which compose the mouth, we have not the proud pretension either of rebuilding this branch of medical science upon a new basis, or of placing ourselves above our professional brethren.

On the contrary, we are anxious to acknowledge to all, not only that this basis has been laid in a solid manner, by Fauchard, more than a century ago, whom we regard with reason as the restorer, or to speak more plainly, as the father of dental surgery,† but we recognise still more the developments that are given to the principles laid down by this celebrated practitioner,

* Nouveau Dictionnaire de Medicine, article Dent.

† It is by order of merit, and not of date, that we place Fauchard at the head of authors who have written upon dental medicine; it is true, the first edition of the work of this illustrious practitioner was not published until 1728, and as far back as 1582, it is said, nearly a hundred and fifty years before, Urbain Hemard had published at Lyons, an Essay upon the art of the dentist, in which some very judicious precepts were found united in the form of doctrine.

by the works of Lecluse, Bourdet, Jourdain, Gariot, and more recently those of M. M. Duval, Delabarre, Laforgue and even Lemaire, forming, by their combination, a theory which has permitted this art to march side by side with the other parts of our knowledge, whose study has for its means and end, the cure of the diseases of man.

But our principle motive in writing, has been to unite in the same treatise all that which medical science, in its different branches possesses more immediately applicable to our speciality, and to make subservient to the establishing of many practical facts too lightly admitted, and even, it is necessary to say it, to the reforming of many errors, an experience acquired under circumstances the most favorable, an experience the extent of which we think no one can, at least without injustice, doubt, so far as the art properly so called is concerned.

For, it is not necessary to conceal the fact, that we are evidently at an age, in which the progress of reason and light, urges the world to free itself from the great evils which induce disease of the teeth, and to conceal the ravages which accident, in spite of every precaution, is liable, at every age, to inflict upon the mouth, forcing the dentist to make the operative and mechanical part of his art, if not his exclusive business, at least, his principal element.

Undoubted truth, by which our professional brethren have daily profitted and regulated their conduct, though very few have had the courage, not to say the sincerity of avowing it publicly. As if our calling, when it may be reduced to the proportions of a mathematical art, even purely mechanical, could not now, by the great services which it renders in this isolated branch, be worthy of the most profound study, and throw some brilliancy upon the career of him, who devotes himself unreservedly to it, without the fear of passing for a limited practitioner, and of being confounded with quacks.

In reducing to its true state, all that which properly belongs to this work, we, doubtless, may omit reproducing by the publication of a complete treatise upon the subject, opinions which have been before expressed, and which have become, for this very reason, the elements of our art. But as there are few

points, in practice especially, that our experience has not demonstrated susceptible, if not of a total reformation, at least, a critical examination, of which, the result may be a modification of the operator's procedure, we should have had difficulty in classifying our remarks, which, being offered separately, would assuredly have lost their importance; which, on the contrary, being methodically interlaced in a complete work, form a compendium expressing exactly the true state of this part of the science, able to serve as a guide for such, to persons who wish to have a precise knowledge of it, and to make it a complete manual.

There will no doubt be objections made to our work, because there exists already many didactic works upon our art, speaking only of those which have appeared in our day. It is true, and, we are far from being ignorant of the fact, as we shall prove sufficiently, and perhaps superabundantly for the good of some, in the course of our treatise; but of these works, generally, only reproductions, commenting, more or less, upon each of those which have preceded them; what then are those which can be called complete works?

Are they those of M. Duval? Without sharing, in any manner, the unjust disdain with which Laforgue treats the productions of this respected teacher, we cannot refrain from avowing that if these productions bear plainly the impress of the erudite, even of the great man, it is the truth, they do not always indicate the marks of a practitioner; and that the most of the excellent precepts they contain are buried under a load of quotations, and figures little calculated to produce that for which they are essentially useful.

Shall we search in the treatise of J. Lemaire on the teeth for that which we are not able to find in the productions of M. Duval? No, assuredly; for that work, though correctly written, contains nothing that can guide the student destining himself to practice, and wishing, consequently, to see in a treatise upon the teeth, something besides a display of rhetoric. It is by an opposite fault, the works of Laforgue err, which consist of only a dry assemblage of practical facts, which, although often detached from the result of critical observation, are not

bound together by any doctrine, and seem rather dictated by a desire to undervalue than to instruct.

Let the works of M. Delabarre, and those of Maury, now occupy our attention. But the first, although they declare the man instructed, and the practitioner as sincerely the friend of his art, as impressed with the dignity of his profession, form not by their union a complete treatise, since they treat of only certain isolated points ; and, we say it with regret, and the love of truth demands from us this avowal, the most important of these works, that one which bears the marks of most originality, his *mechanical dentistry*, offers, to whoever would study it thoroughly, the astonishing contrast of a brilliant theory, and of a practice sometimes so irrational, that it would seem to have been dictated by the blindest empiricism. Thus, by the side of a truly elevated scientific appreciation of the reactors (commonly designated by the name of resorts) we find a description given in the most serious tone of an operation, the object of which, is the attachment of a part of a set of teeth to the upper jaw, *by means of what?—of a band passing across the thickness of the maxillary bone, &c. &c. !! **

As to the work of Maury, written under the influence of that prejudice, which seemed a long time since to confine the dentist within the narrow circle of the part essentially practical of his speciality, everything therein is reduced to the proportions which are rendered useful, only for an altogether summary study of the matter, or to serve as a *memento* to those who know it already.

What we have said of the work of Maury, applies with still more reason, to M. Lefoulon's work, which is little more than a repetition, without the precision of certain practical details ; it has still more a certain wordy air, which betrays its true destination, and demonstrates that the instruction of dentists was not the chief aim of the author, as we shall often have occasion to prove, and as the practitioner himself proves, who thought him-

* The term reactors applies more particularly to springs, such as are usually employed for retaining in the mouth a double set of artificial teeth ; upper dentures were also formerly confined in the mouth by this means.—*Translator.*

self able to say in *thirty-six lines*, all that which concerns *crotchets*, are better and the most habitual means of maintaining permanently in the mouth, the various parts of artificial teeth, and who devotes *four pages* to celebrating the virtues of the most innocent odontalgic paste, which has always been extolled.

Being convinced that honesty is the first obligation, that those who write, contract with society, we shall bring in this exposition, of that which is properly ours, nothing of that reserve and discretion which some of our confreres exhibit in order to make their discoveries, and operatory proceeding, mysterious. They are ignorant how much they render themselves culpable by it; for, if these proceedings are perfect, they injure the propagation of them; if they are only superior to those which are generally used, fortified by others, they might receive useful additions, and, in every instance, render the most eminent services to the public; finally, if they are defective, they are liable, in refusing to allow them to be seen, to turn incessantly in a vicious circle, and often to fall from a position acquired by long and difficult labors.

If the love of science and the desire of general good are not, to the eyes of our professional brethren improperly discreet, sufficient motives to render public the discoveries to which they have been conducted, sometimes by chance, sometimes by a particular position, let them remember that their personal interest, for want of a more noble motive, demands it of them; and if they are blinded by egotism to doubt this fact, let them meditate upon the following words of a master of the art, whose testimony and authority they often invoke. *

“That one who publishes a discovery, ought not to fear that this publication will injure his interests; wealthy men always address themselves to the inventors of useful discoveries, because they think justly that the author of a process is commonly the one who knows how to employ it best. Mystery on the other hand, in a useful thing, always restricts its use; it hinders it from being spread, accredited, and always causes more injury to the invention, than it procures advantages to him. I

* GARIOT: Treatise upon the Diseases of the Mouth.

think, then, that it is always by a false calculation, that one keeps a secret of this nature ; for, in admitting that the inventor of a discovery, experiences some injury in divulging it, this injury could not assuredly be put in the balance with the satisfaction that he ought to experience by its general use."

To employ method in our work, and to bind all the parts which compose it in such a manner, that practical principles shall flow naturally from physiological facts ; that each object shall present itself in its turn, that is to say, following its relative importance, that art, in a word, shall only be the summary of science, we have divided this work in two parts, forming two volumes, susceptible, nevertheless, of being united in one.

The first contains four chapters, forming four principal divisions, the first is devoted to *anatomy*, the second to *physiology*, the third to *hygiene* and to *orthopedia*, the fourth to *pathology* and to *therapeutics* : THIS IS SCIENCE. The second part comprehends, in two very distinct chapters, first, *operative medicine* ; second, *prosthesis*, often so designated under the name of mechanical dentistry ; THIS IS ART, in its most absolute sense.

This plan seems to leave little to be desired by us ; for, if by this simple, methodical, and in fine, logical division that it gives, nothing could have been omitted. In effect, if it is evident that the description of an organ, of whatever part of the body it ought to proceed as an indispensable base, all dissertation upon it, is as clear as its importance requires ; after the organ itself, are the laws of its development, the functions which belong to it, and the conditions upon which the integrity and entire accomplishment of those rest. Hence *anatomy*, *physiology*, *hygiene* and *orthopedia*.

When the preservation of hygiene becomes impossible, disease manifests itself ; hence, *pathology*, and necessarily *therapeutics*, in which we include all which belongs to causes, as well distant and predisposing as near and efficient to the particular character of the diseases of the teeth and even of their principal connections, and to the treatment either medical, or surgical, which is appropriated to these affections, *operative medicine* places itself directly after pathology and therapeutics, of which it is one of the means ; for in dental medicine, it forms one of the most pow-

erful resources, one of the agents to which we are unfortunately most frequently compelled to have recourse. Finally, when art, often unable to preserve, is forced to destroy, and when nature has experienced the ravages of time, in the order it has imposed upon itself, or has not been able to struggle against the innumerable causes of destruction which, at every age, menace incessantly the teeth, *prosthesis* is able, by the innumerable and marvellous resources which it places within our reach, to furnish the means of supplying all the losses that they often experience, so as not only to deceive completely, but even of rendering detection impossible by the most experienced eye—thus :

Part First, Vol. 1.	{	1st. Anatomy ;
		2d. Physiology ;
		3d. Hygiene and Orthopedia ;
		4th. Pathology and Therapeutics.
Part Second, Vol. 2.	{	1st. Operative Medicine ;
		2d. Prosthesis, or Mechanical Dentistry.

In adopting this plan, we are then, as every one sees, almost sure, at least, of avoiding those two shoals, into which the most of our predecessors have fallen, of committing incessant repetitions, under the pretext of avoiding omissions, and of treating in the same chapter, of those things essentially different, as of opiates, powders, and even of teeth brushes, in the development of the materials of dental prosthesis, and of means sometimes very trifling, which insure the regularity of second dentition, through the instrumentality of manual medicine. Do not all these things belong more directly to hygiene ? since they have no other end than to direct the execution of a function and prevent anything from disturbing it, and placing it in a natural condition.

As to the secondary divisions established under the form of paragraphs, every one accustomed to judge a work, will perceive without difficulty, that in adopting those which we have followed, we have constantly had in view, to speak rather to the mind, than memory, by our lectures ; in a word, to make true dentists simple mechanics. In studying in effect each object, we have considered it less following in the order in which it is employed, than in behalf of the principle which ought to serve as a guide for its completion or adjustment.

Thus, to quote an example taken from prosthesis, the most of authors have made only a single article upon the pivoting method of applying artificial teeth: prepared the tooth, furnished it with its pivot, prepared the root intended to receive it, and fixed the tooth to it. The result is, that after having indicated the manner of introducing and fixing the pivot in an artificial tooth, to be placed upon a root, they are obliged to come back that they may place it upon a metallic, osseous or mineral base.

We have, on the contrary, divided this operation into two parts; one which applies to the preparation of the tooth and furnishing it with its pivot, the other treats of the implantation of the pivot into the root. The first is described in the paragraph which relates to the mounting of teeth upon their supports or bases, the other in the paragraph specially appropriated to the description of the different ways of maintaining pieces of artificial plate in the place which they ought to occupy in the mouth.

Being convinced that the materials which ought to compose a complete treatise upon dental medicine and surgery, although regarded only in a practical point of view, are, by themselves, so extended, as to form the base of a voluminous and sufficiently important work to fix the sole attention of those persons who would make it a thorough study; we will carefully avoid the description of certain objects, which, as far as our art is concerned, belong to it no more than other professions, as well as anatomical and pathological, which are the common property of medical science.

Is it necessary to quote examples on this subject? Of what use can it be in a work, addressed to dentists or to physicians who wish to initiate themselves in the particulars of our art, to make a minute description of convulsions, of pthyalism, and of opthalmy, which sometimes accompany the eruption of teeth, since these diseases are described with all detail and possible exactness in the different general treatises of pathology, which study should precede all special application. This description is even fastidiously repeated in all the works devoted to the disease of children.

For the same reason, with what advantage has Maury, who is one of the last writers upon our art, thought to gain by following

that part of his work, on operative medicine, by minute details on the description of forges, the malleability of metals, and the tempering of instruments which we shall use? These different things might, and even ought to be mentioned in their connection with our wares, but not minutely described, for they belong no more to dental surgery, than to cutlery, or to the profession of the jeweller. He might as well have described the labors of Montmartre, under the pretext that they furnished the plaster, which we employ to obtain the representation of mechanical pieces or of prosthesis, or that we are obliged to employ in some irregularities of conformation that we wish to correct. Besides, what could have appeared more inappropriate, to say nothing more, than to devote twenty pages to the natural history of platina and to washing of ashes, and an entire chapter, not only to the treating of certain physical and moral qualities which the dentist ought to possess, but still more to a minute description, pardon us for the expression, of the apartment that he ought to occupy, and of the furniture which should embellish it.

Is it for the sake of erudition that the author whom we have quoted has adopted this course, filled with superfluities, in the midst of which, the end is necessarily sacrificed to the form, the indispensable to the accessory? He would, according to our opinion, been able to have attained his end better by giving an exact account of the recent labors of Cuvier, of M. M. Geoffroy Saint Hillary, Serres and Rousseau, and by putting that part of his work devoted to pathology and therapeutics more upon a level with the actual state of the science.

To say, in effect, in anatomy, that "the teeth are the hardest bones in the human body," and in therapeutics, that, to calm the convulsions which accompany the age of dentition, "they should hold the child as much as possible in the open air, put salt in its mouth and apply cold water to his body," on the one hand, it is to content ourselves with propagating the most common opinion, and on the other, it is, at least, to recommend the remedies of old women, if it is not to advocate irrational doctrines of medicine.

As to ourselves, we will seek no more to shine by a vain display of erudition, a pleasure any one can procure now-a-days, as

every one knows, than to be remarked for a pretentious style. However multiplied may seem our quotations, we have, in the meantime, confined them to the degree necessary to prove that we have read all the important publications upon our art; and when any one shall give himself the trouble of comparing them, he will easily perceive, that we are not content with reading, but that we have meditated upon each author. We shall think ourselves sufficiently erudite, if we shall first omit nothing useful; secondly, if we shall mention all the sources which we have consulted; and we will suppose ourselves sufficiently eloquent, if we are so clear as to be easily understood.

Again, to render profitable and accessible to all the world the researches that we were compelled in obligation to make, we have added to our second part, under the form of an historical notice, a list of most of the authors who have written upon our art, either in a direct, or purely accessory manner. The alphabetical order, employed by some authors in treating upon this subject, appears to us to be completely insignificant to the one who wishes, above all things, to form an opinion of the successive progress of the art, since he is liable to quote, at the same time, works separated by ages, and to place constantly the original work near that which is only a copy of it, we have substituted for it the chronological order. By this means, each work of any importance presents itself to us in the order of its publication, and we will have under our eyes a picture of the principal different phases through which all the knowledge which has conducted to that which we know to-day has passed.

We will divide this history into three periods: the *ancient*, which comprehends all that which has been published upon the teeth from the time of Hippocrates to the sixteenth century; the *middle* includes all the writings of the sixteenth and seventeenth century; lastly the *modern*, which comprehends all those of any importance, which have been published principally in France, in the eighteenth, and all which have appeared in the nineteenth century. In the first of these three periods, we will add the researches of M. Duval, and those which Blandin has more recently made, at the same time being careful to point out with precision the titles of these quoted works, and indicating accu-

rately the period in which the authors which formed this remote period have lived. With regard to the two other periods, we are permitted to contribute the works of M. Dezeimeris, and the public notices contained in some of the medical dictionaries, together with such as we have ourselves discovered, making in all at least one hundred and fifty works more than Maury, who has given the most complete notice.* Hence we will allow no opportunity of escaping by which we can contribute to each epoch whatever it may be entitled to, and in the review which we are about making, in the course of which we will endeavor to analyse faithfully and to judge impartially, we will often be able to demonstrate, by facts, that the disdain which some modern authors show for the works of our predecessors is not always disinterested. But the desire of being just towards some who have preceded us in this undertaking, will never prevent us from declaring the merits of past times, or of forgetting the great progress of our art at the present day.

On the other hand, our criticism will neither be severe or partial. Above all things we desire the good of the profession and the triumph of truth, we attack doctrines, not men, and when names are inscribed by our pen we do it not so much through the desire of elevating ourselves, at the expense of our professional brethren who have written, as it will be to place the reader in a position for judging between their views and our own. If some should occur oftener than others, it is that being placed within the first rank, they make themselves authority, and thereby liable to draw the student into their own errors.

Finally, if we refer continually to dentists who have no art beyond the general principles of the science, we hesitate not to prove that more than one author, having written elementary treatises of surgery or of operative medicine, has committed errors in that part of his work devoted to our speciality, nor having that knowledge which long experience has been able to give for the

* Some persons might perhaps think that this historical part should be placed here. Our reply to this is, the fear of turning the attention from the true motives we had in writing this treatise, prevented us from taking this course, which was the grand object of the introduction, we therefore prefer assigning to it a separate article at the end of the work.

most part to us. Wishing them to respond to our title, which declares not only the art, but still more the science, we have followed, by a natural thread, the progress that each part of this art has made in arriving to our means ; and, in the description of these means, we are compelled as much to make known the proceedings of our professional brethren as our own, reserving for demonstration the reason which have made us prefer ours to theirs.

For the same reason, when we have established a principle, we have nearly always furnished as a support to it undoubted proofs, by facts found in our own experience and in that of authors the most worthy of credit, very different in that from the most of those who hitherto have written in our speciality, in personifying themselves, and in revolving in the sometimes too restricted circle of their knowledge.

Can any one now reproach us with having neglected to treat, as they have done most of our predecessors, upon the different parts which compose the face, nay, even the whole head, principally the interior of the mouth, the pharynx, the velum of the palate, the tongue, for example, the nerves, the veins and arteries which nourish it ? We suppose not, for physicians and dentists know the force of this expression ; there is not one of the latter to whom daily experience has not proved that we are nearly always consulted relative to diseases of the teeth.

Hence it is, that the study of these organs and the means of curing their diseases or of supplying their loss should principally demand our attention ; and this is what we have endeavored effectually to accomplish. To discover the truth and to present it in the most clear terms has been our principal object ? to be useful is our only wish ; should we have attained this, we shall be sufficiently recompensed for the mistakes that we may have committed in endeavoring to give proof of our zeal, that a mistaken rivalry might have taxed with rashness ; but DO WHAT IS RIGHT, HAPPEN WHAT WILL.

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 others.

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 personifying themselves, and in reality as the witnesses too
 restricted circle of their knowledge.

Can any one now reproach us with having neglected to state
 as they have done most of our predecessors upon the different
 points which compose the doctrine, that every subject is treated
 chiefly the interest of the church, the object of the church and
 indeed, the language of the church, the interest of the church and
 which would not be to suppose that for physicians and dentists
 know the force of this expression; it is not one of the means
 to whom daily experience has not proved that we are nearly
 always committed relative to the interests of the church.

Hence it is, that the study of the church is not the means to
 curing their diseases, or of supplying their spiritual wants.
 Fully demand our attention; and thus a lot we have chosen
 and essentially to accomplish. To disregard the truth and to
 present it in the most clear forms has been our object at every
 to be useful is our only wish; should we have neglected this we
 shall be infinitely indebted for the interest that we have
 have committed in conforming to the spirit of our work, that
 mistaken rivalry might have been with indifference but we
 what is meant, rather with our

SCIENCE AND ART OF THE DENTIST.

PART FIRST.

ANATOMY, ORTHOPEDIA, PATHOLOGY AND THERAPEUTICS.

CHAPTER I.

ANATOMY OF THE TEETH.

NATURE has subjected all animals to the obligations of a general law: this is to seek in surrounding bodies for those materials which are calculated to repair the injuries they sustain from the continual succession of the phenomena of life, and after making a proper choice of these materials, to submit them to various preparations, of which the teeth generally speaking, constitute the principal agents.

Hence the teeth, considered in this general point of view, become mechanical instruments, situated at the entrance of the alimentary canal, for the purpose of seizing and dividing the nutritive substances, and frequently to act at the same time as a means of attack and defence.*

Some anatomists have given to the word tooth a much more extensive signification, and have applied it to horns, which occupy the same place in certain animals,† as the beak of a bird; they have also made use of it to designate any calcareous or horny substance, that is seen either at the entrance of the digestive organs, or in the midst of these organs, the object of which is to keep a good hold of prey or to masticate food.

* F. CUVIER: Des Dents des Mammifères, considérées comme caractère zoologique. 1821.

* GEOFFRY SAINT HILLARY: System Dentair des Mammifères et des oiseaux. Paris, 1824.

We do not deny the analogy—on the contrary: but as our object in the present work is to treat solely of human teeth, we have no desire to ascertain how far from truth authors have wandered in undertaking to give an almost unlimited sense to a term which moreover designates any organ having an edged character; we will confine ourselves to the definition we have adopted with Cuvier, and which appears to express in a clear and general manner the organs we intend to treat of in the course of this work.

Teeth have been long considered as real bones; but anatomists and dentists,* who have admitted this identity have depended upon simple appearances which a more critical examination has demonstrated utterly incorrect. Already has Beclard and many other modern authors with him, raised doubts in regard to it, and endeavored to sustain their views by the different characters that exist between these two organs; and which are now-a-day considered perfectly distinct. They differ thus:

1st. In respect to position: The teeth are naked and outwardly visible, whereas bones, and this character is one of the most important, are enclosed in a periosteum.

2d. In an anatomical point of view: Teeth are formed by a bulb, or large papilla, surrounded by a calcareous case, composed of two substances, enamel and ivory. This calcareous case is not visibly penetrated by vessels, and presents no apparent vestige of cellular tissue.† In the long bones is found a medullary substance which bears some resemblance to the papilla of the teeth, but the flat bones are free from it.

3d. In respect to their development: In the teeth the formation of the hard or bony substance takes place from the circumference to the centre; whereas in the bones, this development is made inversely, that is to say, from within outwardy.‡ They afterwards present a renewal that constitutes a second dentition,

* "The teeth are the most durable and compact bones of the body." Maury; *Maury d l'Art du Denteiste*, page 17.

† J. CRUVILHIER: *Anatomie descriptive*. 1834.

‡ M. FLOURENS endeavors to establish that the bony particles are furnished by the periosteum; but this opinion, which is but the reproduction of that of Duhamel, is far from being generally adopted; it has moreover found strong opponents.

a phenomena unparalleled in the history of the development of bones.

4th. In a physiological point of view : Teeth are not as bones, levers to which the muscles are attached, the latter being the principal agents of our movements.

5th. In respect to chemical composition : Teeth possess a greater quantity of salt—and jelly does not penetrate the texture of the enamel, as we shall see hereafter, when giving detailed analyses of all the substances which enter into their composition.

Finally, the best evidence of the essential difference between the teeth and bones, a proof to which no physician or dentist has ever paid any attention, is, that the teeth never contract any real adhesion to the jaws : Now, it is well known how easily the organs of identical nature are united by the simplest pathological effort. Again, teeth known under the name of adherence, are nothing but teeth with diverging roots, upon which the alveolar partitions are engrafted in such a manner, that following out its various windings one would be inclined to believe that they were really soldered together. The most minute researches have never enabled us to prove this affinity, so often discovered amongst the teeth, particularly at their roots,* as we shall soon illustrate by example.

From what has been said, it evidently follows that there is no analogy between the teeth and bone, except that they resemble each other in hardness and color. How then shall we rank them ? in what system of the economy ? We do not hesitate to believe with Cruveilhier, whom we have just quoted, and who has followed the opinion of Aristotle,† adopted by Gallien, and afterwards reproduced by Urbain Hemard,‡ that they belong to the epidermic system. Here are the reasons upon which we found this opinion, so generally prevalent now-a-days.

1st. Examined in the scale of animals, they form an uninterrupted series, from those that resemble the horns and nails, to those that present the most marked bony appearance.

* Let any dentist separate this supposed adherent from the teeth, and he will be assured of the justice of this remark.

† ARISTOTLE : Book 2, chap. 9, etc. *on the Parts of Animals*.

‡ *Researches upon the True Anatomy of the Teeth*. 1582.

2d. Their texture is lamellated like that of the nails and hair. This texture is quite visible in certain animals ; amongst others it is not so, but only on account of the accumulation of the calcareous salts.

3d. Their manner of development is similar to that of horns, nails and hair ; like them, they are deprived of apparent nutritive organs, are formed layer by layer, and are merely the product of secretion. Thus Geoffry Saint Hillary,* as we have already said, considers the beak of a bird, which is evidently a horned production as connected with the dentary formation.

Number and Position of the Teeth.

The number of teeth in young persons at the period of first dentition is twenty, ten in the upper jaw, and as many in the lower. In the adult, this number is thirty-two, sixteen in each jaw. Man has, consequently, in the course of his life, fifty-two teeth : twenty temporary ones, and thirty-two that are permanent.

The teeth, by their uninterrupted series, form two parabolical curves corresponding to those presented by the alveolar arches which serve as their support. These two series or ranges constitute what is called the arches of the teeth. They are kept as if nailed together in the alveolar cavity, which are exactly moulded upon their roots. At the time when teeth were looked upon as real bones, this arrangement went under the denomination of gomphosis.

This relation of contact of the teeth with the alveolar is, however, only mediate. They have an immediate relation with the alveolar prolongation of the gum called likewise *alveolo-dental periosteum*, which envelopes the root, and with the dental pulp that fills their cavity in becoming an integral part of themselves. These are the two true means of union, by the assistance of which the teeth are mechanically fixed in their alveoli. The importance of this means of union will be fully appreciated by bearing in mind the loosening of teeth in persons afflicted with scurvy, and the facility with which they separate and fall in the skeleton.

Each range of teeth, we have already stated, presents a regular and uninterrupted curve ; this arrangement is found

* One of the most philosophical works that has been published upon the subject.

only in the human race. In animals, teeth have an unequal length, and the border of the arches of the teeth is frequently irregular; besides their teeth are not continuous, and leave between them considerable intervals.

Hence it is, that in no animal do we find the teeth arranged with so much regularity and elegance as in man; in children they form a semi-circle, which gives them quite a beautiful appearance. In adults they form an ellipsis which increases the *facial angle*, and gives to the countenance a more stern and marked character.

The arches of the teeth offer to our observation two fronts and two borders. Their anterior front is convex, their posterior front concave; their adherent border or alveolus regularly festooned; their border free, thin and sharp in front, increases gradually on the side where it is thick and with pimples. These arches are not equal amongst themselves: the above one represents a more extensive curve than the one below, so that, placed upon the same line, they form an oval by themselves, the first being the large extremity, and the second the small one, and by approximating they meet each other exactly at the bottom of the mouth, whereas in front, the superior dental arch encases or surrounds the lower. Whoever will examine the arrangement of the teeth upon the *skeleton* during the coming together of the jaws, will find that the incisors below, slip behind those above, that the external tubercles of the lower grinders slip inside of the external tubercles of the upper; it follows, hence, that the first correspond with the gutter that separates in the upper grinders the range of the external tubercles from that of the internal tubercles, or in other words, all the upper teeth increase beyond the direction of their antagonists.

The teeth of the upper jaw are in the general a little more voluminous than those of the lower jaw. In a word, we would remark that no tooth corresponds exactly with that which bears the same name in the other jaw, we can always perceive a circuit of more or less extent, whence results, not merely a simple contact, but an exact fit.

Exterior Conformation of the Teeth.

If we consider the configuration of the teeth, we shall not only find that they possess certain general characters which vary

from all the other parts of the organism, but that they have, moreover, particular characters, which distinguish them amongst themselves. Let us then turn our attention to the first, without making any apology for entering into minute details; for if these details do not always find a direct application in pathology, they become at least of absolute necessity when we wish to remedy, by imitation, the parts which have been damaged or destroyed, which certainly constitutes one of the most important points of our art. Each tooth presents two very distinct parts:

1. One that is free, which is called body or crown.
2. The other which is implanted and concealed in the thickness of the jaw, and differs by its length and by its simple or multiplied condition, which is called root. That sort of contraction which separates these two portions is called the neck.

The crown has a different form, according to the species of tooth we consider. Its summit is entirely flat, only when it is worn by friction. In a perfectly sound tooth this summit is raised by one or many projections called cuspides. Its circumference is more round and projecting towards the exterior than towards the interior. Its entire surface presents a whitish tint, and brilliant glassy appearance.

The root, it has already been said, is simple or complex; in many cases it only offers the traces of a longitudinal division which is not complex. Its form is that of an irregular cone, connected near the basis with the adherent portion of the crown. Its surface presents a yellowish hue, which contrasts with that of this last. In a fresh state it is connected in an intimate manner with the alveolar partition by means of the membrane of the follicle.

The neck is formed in all the teeth, by the reunion of two curved lines, the convexity of which is turned towards the side of the root, and which meet each other by angles on the sides where the teeth correspond. The circumference of the basis of the alveolus does not correspond exactly to the neck, but with the root at a certain distance from the neck. It is this space that separates the neck from the alveolar border, which is occupied by the gum.

The teeth have a vertical direction, or very near it; we generally see, however, that the axis of the upper incisors is slightly

inclined, so as to present a divergence beyond the centre of the alveolar arches. When this obliquity is very marked, it gives to the physiognomy a disagreeable character which resembles the brute. The crowns of all the teeth present a length nearly equal, and we can easily conceive the advantage resulting from this disposition. If the teeth were separated far from each other, mastication could not be easily performed. It is on account of this that, in fractures of the jaw, the surgeon should use all possible care to prevent a harmful consolidation of the fragments, and the irregularity of the dental border which is the consequence of it.

The teeth have, in general, the form of a hollow, irregular, and rather elongated cone, whose large extremity is free and projecting in the mouth, and constitutes the crown, and whose summit, simple or complex, is sunk into the alveolus, and constitutes the root. The conical arrangement of the root, and the exactitude with which the alveolus is moulded upon it, have this double advantage, that the effort of mastication is disseminated through all the points of the alveolus, and that the pressure is not felt at the extremity which receives the vessels and the nerves.

According to form and custom, the teeth are divided into incisor, canine, small and large molars.

The Incisors.

The incisors (*cuneiformes* of Chaussier) are those whose crown have the form of a wedge, with the edge slightly fluted; their office is, as their name indicates, to divide bodies that show but little resistance. They are eight in number, four in each jaw, two in the middle and two on each side; they occupy the front and middle part of each dental arch.

This class of teeth shows its peculiar powers most in voracious animals, such as the wolf and the beaver.

General Character of the Incisors.

Their crown is compressed in the form of a wedge, a little convex in front and concave behind, plain and triangular at the sides. Its basis is thick, continued from the root; its edge free,

a little larger than the basis, and cut obliquely at the expense of the posterior part for the upper incisors, and at the expense of the anterior for the lower incisors.

When the incisor teeth have not been worn by friction, they present upon the edge three small unequal indentations, the middle one being a little more elevated than the side ones.* As to their root, it is simple, flat on the side, of a conical shape, a little thicker in front than behind, and sometimes marked on the sides by a small longitudinal furrow; we have even seen this furrow penetrate deeply enough to bifurcate the summit and even the whole of the root, which should be taken into consideration in placing pieces on a pivot.

Difference in the Characters of Incisors.

The upper incisors are nearly twice as large as the lower ones. The upper middle ones are much stronger than the side ones; but a character that should be particularly pointed out, and which, however, the most critical anatomists, and even Cruveilhier himself, (whom we have so far taken as our guide in our descriptions,) have omitted, is that the middle incisors have an edged border completely straight, whereas, upon the side ones, this border is cut obliquely from within outwardly; so that the four incisors, united together, form, by their free border, a straight line towards the centre, but slightly inclined towards the extremities.

In the lower jaw, on the contrary, the lateral incisors excel the middle ones in magnitude, but this difference is scarcely perceptible. As to their edged border, it is straight in the middle, and rather crooked in the lateral teeth.

Canine or Laniar Teeth.

These teeth, conoides of Chaussier, called canine, from the fact of their being so marked in dogs, and laniar, because they are so well calculated to tear in pieces—are four in number—

* In the canine species this disposition is very manifest; it gives to the tooth the *fleur de lis*, which is more prominent as the animal is younger, and as the tooth is less grown, as we shall see in speaking of the wearing away of the teeth.

two in each jaw. Situated outside of the incisors, they are consequently nearer the support and power which causes the lower jaw to move, and are thereby enabled to overcome greater resistance than the incisors, which are the extremity of the lever.

Hunter has named these teeth *cuspidati*, on account of their pointed top. In carnivorous animals, their strength, however, is fully developed. It is by these teeth that the bear, and even the elephant defend themselves.* In certain fish, these teeth are bent back in the form of hooks, and serve not to tear, but to arrest swallowed up prey.

General Characters of the Canine Teeth.

These are the longest of all teeth, so that they hang over the incisors a little, which is principally noticed in the upper canines. Their crown is conoid, very convex in front, a little concave and unequal behind, and ending with a pointed top but most generally tuberculous, which very frequently overhangs the level of the other teeth.

Their root is simple, like those of the incisors, but much longer and much more voluminous; the alveolus that encloses it has quite a projection in front. Its extremity is sometimes separated in two, but generally characterised by a furrow which indicates two branches united in one, flattened on the sides. The neck of the canine teeth shows, in front and behind, two very marked curves.

Difference in the Characters of the Canines.

The upper canines are longer and thicker than the lower ones, but in the lower jaw the neck of the canine and the neighboring parts of its crown and of its root have a slight projection from the parabolical curve of the dental arch; which is the beginning of the relief we have already mentioned.

* Such, however, was not the opinion of Aristotle and Pliny, who say that the elephant has two great teeth between those which are used for eating, and who regard these two teeth as being of an altogether particular nature. Duval has vainly sought to give some credit to this opinion, in a notice inserted in the seventh volume of the *Memoirs of the Royal Academy of Medicine*; the opinion of Daubenton, corroborated by the researches of Cuvier, is more generally admitted.

The roots of the upper canines correspond to the ascending apophysis of the submaxillary bone, and in some individuals become longer until they arrive at the basis of this apophysis. As these roots are directed towards the socket of the eyes, some have been ignorant enough to suppose that they were in some way connected therewith, and in consequence called them eye flaps. So evident is such an error that we scarcely deem it necessary to combat it; we will simply observe that the length of their roots explains the difficulty frequently met with in their extraction, and, moreover, the accidents which may result therefrom.

The Molar Teeth.

The molar teeth have a cuboide crown, the end of which is filled with tubercles, which are designed to grind like a mill. Hunter calls them multicuspides; but the small ones having only two nipples, are likewise designated under the name of bicuspides.

The molars are twenty in number, ten in each jaw. They occupy the five last alveoli of each half of the dental arch, and consequently are found nearer the point of articulation than all the teeth, which gives them, as we shall hereafter show, a very advantageous arrangement for having a powerful pressure upon the bodies which any one wishes to crush against them.

Teeth of this class have, for general characters, in the first place a flattening of the top of the crown, and, consequently, a much greater extent of the triturating face than that of the two kinds already described. Their faces are parallel, that is to say, do not approximate to form a sharp or angular border. Their surface is unequal and projecting; their crown is round and a little square, and rather short in a vertical sense. Their roots are numerous.

General Characters of the Bicuspides.

We already know they are eight in number, four in each jaw, two on each side, and occupying the space which is left between the canine and the big molars, so that a line that would cut the orbit in two equal parts would fall into the interstice that separates the second small molar from the first of the three

large ones. Their crown is cylindrical, about as large as that of the canine, compressed according to the diameter which corresponds with the parabolical curve of the dental arch; the anterior and posterior *faces* are even; the two others, that is to say, the internal and the external, are convex.

The smooth extremity of this crown presents two short conoid tubercles, one externally, a little larger, the other internally, separated by a furrow which follows the direction of the arch. As to the root, it is unique and *bifid*; but in the first case it is deeply furrowed in its length.

Difference in Characters.

The small lower molar teeth are not so strong as the upper ones, from which they moreover differ by the direction of the crown, which is slightly bent in by the wearing out of the external tubercle. The first, a little smaller than the second, often presents but a single tubercle, which is the external, an arrangement which very often gives it some resemblance with the canine it touches.

The tubercles of the small upper molar teeth are separated by a furrow more marked than that which divides the tubercles of the lower ones. In these they are sometimes reunited. The second from above presents, in the majority of cases, two roots, which makes it different from the others.

To find, as a modern author* has done, the reason of this double root of the small upper molar teeth, in the fear that nature had that they might fall, is truly a subtlety which many persons will be astonished to meet in a work given as a serious labor.

General Characters of the Large Molar Teeth.

They are twelve in number, six in each jaw, three on each side, and occupy the remotest part of the alveolar arch. The last has received the name of wisdom tooth, on account of its late appearance. Their crown is much larger than that of the preceding ones; its form is cylindrical, a little flattened on the two sides by which they correspond with each other, but round

* LEFOULON: New Treatise upon the Art of Dentistry, page 29.

and convex on the external and internal fronts. Their free and triturating surface is covered with four and sometimes five unequal tubercles, cut into facets, separated by a crucial furrow, and often by small *dimples*. Their root is always double or treble, and in this case one of the branches presents a longitudinal furrow, which indicates the union of two in one. Sometimes it is quadruple or quintuple, but varies according to length and direction. These roots are sometimes diverging, sometimes parallel; and frequently, after wandering off, they come together, and bend in the shape of a hook, which embraces a greater or less portion of the maxillary bone. When the teeth present this *disposition*, which is not very rare, they are called *barred* teeth, they cannot be extracted without extracting at the same time the bony portion which they embrace. All contrary pretension would involve an absurdity.

Difference in Characters.

The crown of the large lower grinders projects somewhat inside; that of the upper is entirely vertical. The large lower grinders are the only teeth that have a more bulky crown than those which correspond with them above. It is easy to distinguish the upper from the lower by ascertaining the arrangement of their roots; thus, in the lower ones, the roots are two in number, one in front, the other behind. These roots are very strong, large, flattened from behind in front, rather deeply furrowed according to their length, and bifurcated at the top. The upper teeth have generally three roots, two external, which are frequently united, and one internal, most commonly very diverging.

The first large molar tooth is distinguished from the two others by its bulk, which is generally quite considerable. Its crown has generally four, and sometimes five tubercles, two within and three on the outside. The second, not quite so bulky as the first; is attached to the lower jaw by four tubercles, separated by a crucial groove, which is less regular in the upper jaw, its body has a rhomboidal form.

As to the third large molar, or wisdom tooth, it is distinguished from the first and second by its bulk, which is some-

what less at its crown, which has generally but three tubercles, and at its axis, which considerably directed inwardly at its roots, which are sometimes completely united in one. But in this case we never fail to find in it all the characteristics of the molar teeth, that is to say, the vestiges of three roots, blended in one for the upper root, and in two for the lower one. Furthermore, the wisdom tooth is that which contains more varieties, and frequently, instead of taking a perpendicular direction, it takes an oblique course, both inside and out, and instead of presenting three or four tubercles, it only presents two or sometimes but one; whereas, in some instances, we have seen its crown divided into six, eight, and even ten tubercles ranged in two lines, and separated by a furrow, or sufficiently deep depression.* It is even sometimes found in individuals in whom it remained buried in the thickness of the maxillary tuberosity.

Structure of the Teeth.

But very few parts of the organization of man have engrossed the attention of anatomists more closely than the structure of the teeth. If we reduce to the most precise data, what has been written on the subject of the teeth, we shall find that they are essentially composed of two substances; one external, hard or cortical, which only offer slight marks of organization, that its resemblance with the general tissue of the bones gives them the name of *osteoide*, and divides itself into *ivory* and *enamel*; the other internal, soft or pulpy, deeply organized, called *pulp* or *kernel* of the tooth.

Hence we see that the teeth are not full, but hollow near the neck, and as far as the centre of the crown. This cavity presents nearly the form of the tooth upon which it is examined. It is generally the more considerable the less the individual is advanced in age. Frequently it is obliterated in the adult. Closed on the side of the crown, it prolongs in contracting more and more towards the summit of the root, and there opens, following the number of roots through one or many holes

* LEMIRE gives, in his *Treatise upon the Teeth*, a very curious example of this sort. We have many of them.

through which an artery, a vein, and a nerve pass. It contains the pulp or dental papilla.

The hard, or cortical portion, is likewise composed of two substances, as Eustachius* has already demonstrated—one that lines the crown, and only the crown†, with a vitreous layer, of little thickness, and grows thinner as it approaches the neck: it has been called enamel on account of its resemblance with the glassy covering of the porcelain; the other, which forms the entire root, and the deep portion of the crown, is the ivory which has also been improperly called dental bone.

The enamel is a particular substance, unequalled in the economy, semi-transparent, principally in the teeth of first dentition, variable in color, not only in the same individual, but even in the same range of teeth, from the white of milky or bluish pearl, to the deep yellow, partaking even of the brown. Its texture is eminently fibrous, which is easily perceived when studied from the fragments of the crown, where it is quite evident that the enamel is composed of short fibres, which are a sort of crystalline needles, strongly pressed one against the other, and raising themselves, not exactly perpendicularly, but rather obliquely from the external surface of the ivory.

Many modern authors seem to give this fibrous texture of the enamel as an anatomical fact, the discovery of which they claim. They are mistaken, for this texture has been long known: as a proof thereof, we will merely quote the following passage from Lahire, published about fifty years ago:‡ “The substance of the enamel is composed of an infinitude of small *fillets* which are attached to the internal part of the tooth by their roots, almost in the same way that the hair and nails are to the parts they are connected with. This composition is very easily seen on a broken tooth, where we perceive that all these *fillets* are very much inclined towards this part and almost perpendicular upon the

* EUSTACHE: *De Dentibus. Vide opuscul anatemi.* 1574.

† An anatomist, named Bertin, believes, however, that the enamel extends in an extremely thin layer over the whole surface of the root; but surely he has no authority for this assertion.

‡ Memoirs of the Royal Academy of Sciences, 1699.

basis of the tooth : by this means these fillets resist better the efforts they are obliged to make in this place."

The enamel is extremely hard, and this quality is one of its most powerful elements of stability. As long as the teeth are covered with it, they resist the greater part of the causes of change that arises from the bodies with which they generally have relation ; but as soon as the ivory is exposed, they deteriorate* very easily. In old skeletons, when all the other parts of the tooth are reduced to dust, the enamel still preserves its consistency and solidity. This extreme hardness causes the enamel to be quite brittle ; and the sudden percussion of a hard body is able to crush it, or to deprive it of its brightness.

The thickness of the enamel is very variable. In some persons it forms a great part of the crowns of the teeth, while in others it is found in very thin layers ; always thicker in an adult than in a child, in the large molars, than in the canines, and in the latter than in the incisors, it is more marked at the triturating extremity of the tooth, and is worn with time by the effect of friction, and almost disappears in old people.

Although Mascagni† considers the enamel as entirely formed of absorbing vessels, it has nevertheless been hitherto utterly impossible to discover the least trace of vessels. Injections never penetrate it—the use of the madder never colors it with red ; subjected to fire, it separates from the ivory, blackens a little at first, tarnishes and becomes brittle after having resisted a longer time than the ivory of which we shall soon speak. By plunging the enamel into nitric acid, slightly tinged with water, it dissolves, and assumes a whitish color. Scraped with a sharp instrument, it is reduced to dust, which distinguishes it from the ivory which is divided into very thin plates, and forms a sort of chip similar to those obtained by planing wood with a straight fibre.

The chemical analysis of the enamel has been frequently

* This assertion, however, ought not to be received in an absolute sense, as we will show in the part devoted to pathology, when treating of *caries and the wearing away of teeth, etc.*

† *History of the Lymphatic Vessels of the Human Body, etc.*

made, but we consider the following of Berzelius as most satisfactory. According to him it contains,

Phosphate of lime,	85.03
Carbonate of lime,	8.00
Phosphate of magnesia,	1.05
Animal matter and water,	.20
	94.28

The results obtained by Peppys, vary but slightly from these. This chemist merely pretends with Hatcheff, and, contrary to the analysis of Fourcroy and Vauquelin, that this substance does not contain any cellular or cartilaginous tissue. We are inclined to admit this last opinion, because it is founded on the entirely inorganic appearance of the enamel.

The ivory constitutes, alone, almost the entire tooth of which it forms the root entirely, and the body in a great measure. It is neither as hard nor as brittle as the enamel. It is of a yellowish white color; its texture extremely thick; neither fibres nor cells are discernible in it, but it is easy to perceive a lamelious disposition, particularly in the crown which appears evidently to have been formed from *concentric* layers, of horns set in each other, and parallel with the exterior surface of the tooth. The root does not present, distinctly, this *disposition*. Its fracture has generally a silky and *variable* appearance.

This part of the tooth is composed of calcareous and animal matter, as is demonstrated by the analysis we intend to give of it; but the point that has caused most discussion, is to know whether it possesses vessels or not. Blake* and Fox, relying on the tumefaction and softness so remarkable near the root, together with the soldering which they imagined they observed, with the alveoli, have come to the conclusion, that vessels should be admitted into it. There are, however, strong and numerous arguments for the adverse opinion. Thus it is evident that the injection does not penetrate it. Once formed, it wears out by friction like an inorganic body without the least appearance of a nutritive motion.

* *Dissertation upon Dental Formation, etc.* Edinburg, 1778.

Beclard, unwilling to admit a vascular communication between the ivory of the crown and the dental pulp, thinks, nevertheless, that the ivory receives continually from the latter, a liquid by imbibition : that in consequence, it is in regard to the pulp, in the same condition that the hair, nails, horns in general, are in respect to the vascular part of the skin. As to the ivory of the roots, we think that its texture, organic action, and morbid alterations developed in them, with the further proof of the vessel's continuous with those of the organism in general, authorise the belief that the question is solved in favor of their presence.

Whatever may be the organization of ivory, air cannot easily penetrate it ; and, if subjected to the action of nitric acid, it acts like the tissue of bones, that is to say, its calcareous substance is dissolved, and there remains in it a parenchyme, both tenacious and flexible, having neither a fibrous nor an alveolar appearance ; when, on the contrary, it is submitted to fire, it burns in diffusing an odor that depends upon the presence of the gelatine, becomes black, and leaves a white, hard, and brittle substance.

Berzelius found in the ivory substance in one hundred parts :

Phosphate of lime,	61.95
Fluate of lime,	2.10
Phosphate of magnesia,	1.05
Carbonate of magnesia,	5.30
Salt and chloride of sodium,	1.40
Animal matter and water,	28.00

According to Peppys, the roots are formed of one hundred parts of

Phosphate of lime,	58.0
Carbonate of lime,	4.0
Animal matter,	28.0
Water and loss,	10.0

Desirous of procuring a more recent analysis of the part that constitutes the osseous tissue of the tooth, we have requested Doctor Fory, professor of medical chemistry, and at present principal apothecary in the Hospital of St. Louis, to have the kindness to make it. This honorable chemist obtained the following results :

For the ivory matter of the crown, free from enamel :

Phosphate* of lime,	61.93
Fluate of lime,	2.12
Phosphate of magnesia,	1.05
Carbonate of magnesia,	5.29
Salt and chloride of soda,	1.51
Animal matter and water,	28.00

For the root :

Phosphate of lime,	58.00
Carbonate of lime,	4.00
Animal matter,	3.00
Water and loss,	11.00

Hence the ivory differs much from the enamel, for it contains a little animal matter similar to that of the bones, as is demonstrated by these analyses, and as can be easily seen in many preparations deposited amidst the collections of the faculty, whereas the enamel is almost entirely calcareous. This presence of a cartilaginous matter in ivory, and its manner of acting in regard to the caloric, which acts upon it precisely as it does upon the bones, although insufficient to establish a similitude between the ivory and the bones, are nevertheless daily called in requisition, and will shortly be so for the purpose of explaining certain diseases of the teeth, which are, notwithstanding, all that can be said, the most striking resemblance with those of the osseous system.

As to the union of the enamel with the ivory, Cuvier* pretends that there exists between these two substances, a line that terminates at the neck, and continues with the plate of the follicle, which adheres to the root of the tooth. This learned anatomist considers this line as indicative of the existence of a very fine membrane, which envelopes the papilla, when no part of the ivory is transuded. As this papilla gradually separates from the ivory, it draws inwardly, and also separates from the membrane, which always serves as a common tunic, both to the membrane and to the matter which it transudes underneath. The enamel on its part is deposited upon this tunic by the pro-

* *Studies and Researches upon Bony Tissues.*

ductions of the internal plate of the capsule, and is in such a manner compressed by it, that it soon becomes imperceptible in the hard portion of the tooth, or at least appears on the cap of the tooth only as a fine greyish line that separates the enamel from the internal substance.

M. Duval has latterly very strenuously insisted on the importance of this line, and M. Blandin* says positively, that he has found, and announced in his courses, the membrane that it represents. Blandin goes so far even as to compare the relative disposition of the ivory and the enamel of the teeth to that of the osseous extremities and the cartilages of the articulations, and considers the membrane of which we speak, as performing the duties of the synovial which is placed between the bone and the cartilage.

The soft portion or dental pulp, occupies the cavity which exists in the tooth, and exactly represents its form. It is, says Cloquet,† a sort of ganglion, of exquisite sensibility, following the vascular and nervous pedicle, which enters by the root, and of which it only appears to be a rudiment. Being of a greyish color, and a soft mucous substance, it is intimately connected to the vessels and dental nerves by means of a vascular and nervous pedicle which penetrates the root of the teeth by the aperture that perforates its summit.

Blandin considers the pulp or dental kernel only a continuation of the dental follicles. He uses the following language in reference to the subject: "The dental follicles are placed in the alveoli in the same number as the teeth. They are small sacs formed by depressions of the mucous membrane on a level with the neck of the tooth. Exteriorly they are intimately connected with the alveolar periosteum, and sink into all the anfractuositities of the alveoli; interiorly, the follicle that comes out of the alveoli is filled by the root of the tooth to which it strongly adheres; its buccal aperture embraces the neck and remains there; its bottom gives birth to the papilla or pulpous kernel."

We insist on this opinion, because it corroborates what we have already established, which is, that there is great analogy

* *Anatomy of the Dental System, in respect to Man and Animals.* Paris, 1836.

† *Descriptive Anatomy, with plates.*

between the dental follicle and that of the hair and of feathers, or to speak in more explicit terms, between the tissue of the teeth and that of the various epidermic productions. Both follicles are formed by a fold of the tegumentary membrane; both, says Blandin, are principally connected to the neighboring parts by a nervous and vascular pedicle; both have a contracted neck adhering to the organ which they produce, and surrounded by a follicular circle; both give birth to a papilla; in fine both enclose, the first the tooth, the latter the hair or the feather.

The only very sensible difference, continues the same anatomist, which separates both follicles, consists in this, that the dental is mucous, whereas the hair and the feather follicles are almost always cutaneous, inasmuch as the first is sunk into the alveoli, whereas the other is sunk into the general cellular tissue, and finally, because the papilla of the dental follicle is pedicular, whereas that of the piliform follicle in particular is sessile and tubulous. This last difference explains the limited increase of the tooth, and the indefinite development of the hair, as we shall see when treating specially of the dental follicle in the chapter devoted to the physiological history of the teeth.

To what has just been said let us add only that the swelling that forms the dental pulp is penetrated by a great number of bloody vessels and nervous fillets. The presence of the latter explains the excessive sensibility of this pulp, to the irritability of which a great many authors have attributed the various diseases of the teeth, and even all that has been written on the sensibility and vitality of the teeth. Cuvier goes so far as to consider it almost as delicate as the gelatinous substance of the pit of the ear.

In an excellent dissertation, published in 1817, M. Serres,* whose researches on this subject have served as a guide for those who have since turned their attention to the apparel of the teeth, has described a series of small bodies which he calls glands of the teeth, and which are placed in a circle on the alveolar borders around the neck of the follicle.† These bodies

* *Essay upon the Anatomy and Physiology of the Teeth.*

† To be just, it is necessary to aver that Hippolytus Cloquet had written upon them before Serres; see his *Traites upon Descriptive Anatomy.*

are themselves small follicles that secrete a matter intended to lubricate the alveolar border before the teeth come out, and which, according to him, would afterwards form tartar.

This last supposition unfortunately falls before the observations of Em. Rousseau,* who, acknowledging the existence of these glands, has, nevertheless, proved that they disappear after the eruption of the teeth. These bodies exist effectively, we are positive of it, but we think with Blandin, that these are absolutely unknown to tartar, as we shall have occasion to prove hereafter, and we believe they are more similar to the follicles that are found around the neck of the matrix of the hair. Delabarre acknowledges their existence; but he thinks they belong to the nervous and salivary apparel, and that they secrete a part of the fluid intended to sustain the flaccidity and elasticity of the gums.

Teeth of First Dentition.

The anatomical characters which we have described belong exclusively to the teeth of adults, that is to say to those of the second dentition. But in an infant of the age of two or three, there are teeth of so different a character that we feel obliged to examine them separately. Upon the precise knowledge of the characters peculiar to them, practical facts of the highest importance are established.

These teeth are called infantile or milk teeth, because they are peculiar to children, and make their appearance generally when the child is at the breast. They are likewise called temporary, in opposition to those we have described, and which are called permanent.

The milk teeth are twenty in number, ten in each jaw. We will merely designate the characters by which they are distinguished from the permanent.

Their color, instead of being an ivory white or of a clear yellow, is a bluish or azure white. The incisors and canine teeth are always distinguished from the permanent incisors by a less bulk and by the shortness of their roots, which frequently are entirely destroyed, as we shall show when treating hereafter of

* *Comparative Anatomy of the Dental System of Man and the principal Animals.* Paris: 1827, 8vo., with thirty plates.

the physiological phenomena, by aid of which both species of teeth succeed each other.

The two molars, that is the small ones, differ widely from the same teeth in the adult; they approach very near to the large molar teeth, from which they are distinguished by the small height of their crown, which is cylindrical, and presents firm tubercles to the triturating face, three of which are outside and three in.

The small molar of the adult have generally only two tubercles, and the large ones four, as already stated.

Considered in regard to their bulk and general arrangement the infantile teeth present moreover the two following characters: like the permanent they are stronger in the upper jaw than in the lower; but they do not form by their union, as the permanent parabolical ranges, but two arches which resemble the bows of a circle, and differ but little from each other.

The comparative chemical analysis of the teeth of both dentitions also demonstrates that those of the first contain a little less phosphate of lime than those of the second. It is to this small quantity of salt we must attribute the transparency or milky appearance, and principally the great alterability of the milk teeth; they are also frequently affected with decay when falling out to leave room for others that succeed.

Finally to complete the history of the human teeth, considered in different ages, we annex an analysis made by Laissaigne, professor of chemistry in the veterinary school at Alfort.

Objects submitted to analysis.	Animal matter in one hundred parts.	Phosphate of lime, one hun- dred parts.	Carbonate of lime, one hun- dred parts.
Teeth—			
Of a man 81 years of age,	33	66	1
Of an adult,	29	61	10
Of a child 6 years of age,	28.05	60	11.05
Of a child 2 years of age,	23	67	10
Of a child 1 day old,	35	51	14
Of an Egyptian mummy,	29	55.05	15
Cartilage of the gum			
Of a child 1 day old,	86.07	11.03	2
Dental pulp			
Of a child 1 day old,	77	23	6
Dental sac			
Of a child 1 day old,	57	37	6

Varieties and Anomalies of the Teeth.

The teeth, perfectly identical in both sexes, present numerous varieties, and frequently very strange anomalies. Blandin* attributes these varieties to three circumstances: age, race and individuals; but as he is obliged to confess that races only impress upon the teeth insignificant varieties, and as the researches to which we have a long time had recourse for the purpose of making our collection one of the most complete, have convinced us that the differences which sometimes exist in the teeth of certain people are less the positive consequence of natural characters than the result of certain habits, we will only admit two orders of varieties: those that depend on age, and those that relate to individuals.

Varieties of Teeth according to Ages.

We have already traced some of the characters which the progress of life impress upon the teeth: we have now to present the following considerations:

The root of a tooth is always developed differently from the crown. In a very young child, the root, properly speaking, does not exist, but the crown, on the contrary, has already nearly acquired the size it should afterwards have. In a little more advanced age, the root is far from having attained its entire length, still the crown begins to wear out at its extremity. In an adult, some teeth have already lost, by use, the small projections with which the top of their crowns are furnished, and their roots have ceased for a long time to increase. Finally, in old age, the crown is sometimes completely destroyed, while the root is still completely perfect; so that their natural destruction takes place in the order of their development.

The shedding of the teeth follow the same order as do their eruption. Thus, this prelude of destruction commences with the incisors. Is it because being first developed, they are shed before the others? It is one reason without doubt; but the thinness of the summit of their bodies, and the frequency with which they are used in man are likewise two perfectly admissible reasons; the enamel furthermore is not so thick at their extremity as upon the other teeth.

* Work quoted.

At the expiration of a certain period, which varies according to a number of circumstances, but particularly according to the condition in which the teeth are after their formation, the small nipples with which the tops of their crowns are mounted have disappeared, and with them all the enamel that covers their summit. It is this condition we allude to when speaking of a tooth that is rased. In this case, the centre of the triturating surface presents a yellowish hue, and its circumference is surrounded by a line of a white color.

In proportion as a person advances in age, the wearing of the teeth progresses. In old age, it frequently removes the entire crown, without, nevertheless, the dental cavity being opened; this depends, as we shall soon hereafter see, on a new deposit of bony matter which presents itself like a stopple to protect the cavity.

Hence, it necessarily follows from what precedes, that teeth, in the same degree as they are worn away, should furnish positive data for the determination of ages. This can be exactly ascertained in animals who have uniform food or a regular way of living; but it would not be so in a man whose food is as various as his tastes, and on whose teeth are impressed diseases which modify their composition and render their destruction more rapid. In considering these circumstances we are enabled to obtain results of much importance. We will soon return to this question.

Varieties of Teeth according to Individuals.

There is certainly no organ that offers so many varieties as the teeth. In order to conform with the general order, we will refer these varieties to five principal heads—to number, form, direction, position and structure.

Varieties in number: These are either varieties by default or by excess. The first consist either in a total absence of teeth, as Fox, Borelli, Labatier and Baumes have quoted examples, or in the absence of a great many, as in a subject that we have known who only had in each jaw four incisors, and as Schmitt and Fauchard have observed; or, in fine, the absence of one or two teeth only, a conformation which appears hereditary in some families, sometimes it is a canine, again an incisor, which has not appeared.

It is not unfrequent to find individuals, particularly women, whose wisdom teeth never appear, especially in the lower jaw; but generally in this case the tooth remains concealed in its alveoli, or in the thickness of the branch of the jaw, and finally comes out, for we think that a slow tooth is, if not the agent, at least the motive of an effort of expulsion which ceases only at its egress.

We will remark that the anomaly in the development of teeth, which goes so far as to leave the jaws entirely naked, is extremely rare; we have never seen it personally.

As to the absence of one or more teeth, we frequently observe it in the large molars, and in some cases, we repeat it, their fault is only apparent, and depends only on the fact that they remain enclosed in their alveoli beyond the time when they generally appear. Doctor Devaut* furnishes an example of one of his fellow students who died at the age of eighteen, in Paris, with five teeth less in the lower jaw, three molars on the right and two on the left; his gums were large and swollen, undoubtedly on account of the germs they contained, and did not present the edged border which the gum of the newly born offers. He never remembers having had any teeth at this place, and never were any extracted from him. It is furthermore said that a magistrate of Frederickstadt† never had any but molars, and no canine or incisors.

Fauchard has left us the curious observation, of a child five or six years old, in whom the greater part of the teeth had not appeared. Brouset, in his excellent *Treatise on the Medical Education of Children*,‡ likewise speaks of an individual of the age of twelve, who only had the half of his teeth, and whose alveolar border had acquired the consistency of the gums of an old person.

Finally, there is no tooth whose absence has not been either separately or conjointly with others observed. The decrease of the number of teeth because two or more of them are united together, is a rare anomaly; but we think it less inju-

* *Essay upon the Nature and Formation of the Teeth: Inaugural Thesis.* Paris, 1826.

† See the *Ephemeris of the Nature of the Curious.*

‡ Volume first.

rious than their absolute absence, for we have met with many examples; we have, amongst others, two incisors on the same side united in such a way that in reality they form but one. What is hard to admit is the reunion of all the teeth in the same jaw: the examples of this sort related by Pliny, Plutarch, Bartholin, Melanthon and some other authors, historians or naturalists, are probably nothing else but facts badly observed.

As to the union of two teeth in one, this is done either by the crown or by the root, or in fine by both. The first case is more common for the incisors, and the second for the molars; and in carefully examining the examples of this last case, we are compelled to admit that there is not always direct adhesion, but connexion through means of the ossified dental alveolar periosteum; that is to say, that it is a sort of ankylosis formed by the union of the roots of both teeth through the inter-alveolar partition, afterwards destroyed by the inflammation of the dental alveolar periosteum.

The union of the crown, on the contrary, is a real fusion of the two teeth, in which the ivory substances are common to each other. It takes place when the teeth are still in an embryo state: two germs have been formed very near each other—the intermediary portion is not developed—they then remain in the same alveoli, their two papillæ are confounded together and the calcareous layers, after being extended over this double papilla, separated for the purpose of forming the roots of the confounded teeth. If we form our judgment by the cases which we have observed; the union of the canine with the lateral incisor, would be much more frequent. This is explained by the strong pressure which the canine always exercises upon the lateral incisor from its formation.

The excess of teeth always depends on the duration of those of first dentition. Likewise those teeth which are called supernumerary; whether they appear separately, or whether they form a complete series, almost always show themselves behind the others. There are, nevertheless, circumstances in which we are obliged to admit the existence of third germs in the jaws. Such undoubtedly was the case of the son of Columbus, the

anatomist, and that related by Serres* of a servant of Geoffroy, physician in the Hotel Dieu, who had a double range of teeth, forty in all. We are frequently deceived in regard to the existence of the supernumerary teeth. We have frequently, by inspecting the mouth, proven to persons who imagined they were thirty years of age, that they were deceived by simple appearances.

Finally, a variety of teeth which comes under this class, is simply the internal existence of supernumerary teeth. We have many examples in our collection: in one, the tooth is stopped between the roots of a large molar: it is represented in plate 8, in the work of Maury, to whom we have entrusted it; in the other case, it is developed in the cavity of another tooth, which it has split: in a third, we see a cell in the thickness of the upper maxillary, immediately beneath the nasal bone, on the very line of separation of the two maxillary bones.

Variety in the Form of the Teeth.

It is reasonable to consider the most part of the varieties of form the teeth offer, as results of a morbid state, which has affected them at some period of their development. But we can likewise admit that a simple pain could have determined some of the various and capricious forms they offer in many cases.

Sometimes there are teeth of immense size, or of extraordinary smallness; sometimes we meet upper incisors, bent upwards in form of a hook, or having a double hook. Some likewise diverge from the crown and the root towards the neck, in form of the letter Z; whereas, others bend in the form of C. We, moreover, find crowns surmounted with an unfinished tooth; finally, crowns absolutely deprived of roots, and roots of crowns. But in enumerating all the varieties of form we have in our possession, we are compelled to admit that the extreme affinity, and the excessive divergence of the roots of the large molars are, if not the most remarkable, at least the most common; for, in twenty teeth of this kind, we do not frequently meet with four

* Memoir quoted, page 134.

that have the same form. We should observe that these varieties of roots are seldom seen, if ever, in the milk teeth.

Finally, a variety of form that is common enough, and which has not been remarked by any author, is the depression in form of a horn, from the posterior face of the anterior teeth, and of which the enamel has perfectly followed the contours.

Varieties in the Direction of the Teeth.

As these varieties are frequently accessible by the means of art, we will return to them by-and-by. In the mean time, let us here observe, that authors are much mistaken in saying, that these anomalies of direction are sufficiently rare; for, from the simple obliquity to a complete inversion, there is a number of bad directions, which it is useful to know, together with their causes, and which might possibly be corrected.

Varieties of the Position of the Teeth.

The annals of medicine exhibit very remarkable examples of the transposition of the teeth. It must certainly be interesting to the surgeon dentist to know something of it; for, this knowledge may be his guide in the appreciation of a tumor developed in the vicinity of the dental arches.

This variety consists in a simple deviation of the position which the tooth naturally occupies, but there is also sometimes a complete transposition—a real error in position. The first case is well explained by the improper directions which the teeth may assume; those particularly of the upper jaw, which sometimes leave the alveolar border, either to be transferred to the side of the palate, or in any other direction, or to be placed entirely across the alveoli. But it is difficult to explain the cases of complete transpositions, or rather they cannot be explained; they may be observed and noticed. Here is a summary detail of the anatomical pieces, the most remarkable of this sort is in our collection:

1. In an adult, a canine, on the right side, which is placed across the arch of the palate, adhering to the partitions of the

alveoli which contain the two incisors and the small canine, but without any communication with these alveoli.* A dentist of the last century, found an almost similar case in an organist of Payenne; but the tooth, instead of being a canine, was a molar; and, instead of adhering to the alveolar partition, it occupied the very centre of the palatinal arch.

2. A canine on the right, and of the second dentition, which remains in its alveoli, but continues to increase towards the wings of the nose, and having, by the development of its crown, burst the alveolar partition, at the expense of which it was produced.

3. A canine that lies across the anterior part of the palatinal arch, adhering to the alveolar arch of which it destroys the entire plate to the extent of nearly three centimetres.

4. Two wisdom teeth, of which are entirely enclosed in the thickness of the branch of the maxillary bone, bursts the external partition; the other only showing a light part of the crown in the thickness of the base of the coronoid apophysis, but directing itself from behind in front, and not from above downwards.

5. A small molar having completely perforated the body of the lower jaw, above the mental foramen, having its crown perfectly formed, and its root equally perfect, but bent posteriorly.

Varieties in the Structure of the Teeth.

Those varieties of which authors are merely pleased to announce the possibility, without furnishing a single example, are sufficiently numerous, and depend, it is true, frequently on morbid causes. The most curious we possess of them is the incrustation of a root of an incisor by a layer of enamel, but the deposit, on different points of the roots of many molars, of small particles of enamel, which seem to escape from a brush intended to cover the crown with this greenish varnish; Doctor Devaut† says that he has seen an example of this last case at

* COLENDRE: see *Essay upon the Most Frequent Diseases of the Teeth, and upon the Proper Means to Prevent and Cure them.* 1781.

† Thesis quoted.

M. Dumontier's of the Faculty of Paris. In this sort of varieties should be put not only this unequal distribution of enamel, which often presents lumps, hollows, holes, but, moreover, the exostoses which so often develop on the roots, the complete obliteration of the dental canal, the formation of the osselet which prevents the opening of this cavity, finally, the transformation of a tooth into a cartilaginous tissue, as we have many.

THE MAXILLARY BONES AND THEIR ALVEOLAR BORDER.

After the teeth, the parts of anatomical study most important to the surgeon dentist, and of which the conformation should always be present to his memory, are the maxillary bones, in which they are planted. These bones are three in number, two above and one below. The two first form, if not the whole, at least the greater portion of the upper jaw. The other, by itself, forms the lower jaw.

Fixed immovably to the bones of the skull, the two upper jaws form, by their reunion, the middle part of the face. Considered in all they possess of importance to the dentist, each of them offers two very distinct portions—a vertical one, called ascending apophysis, and by means of which they lean upon the frontal bones in forming the contour of the anterior aperture of the nasal bones—the other is horizontal, and forms the body of the bone; let us enlarge upon this a little.

The body of the upper jaw presents three faces, one external, one internal, and one above. The external face commences at the point of junction of the two bones upon the middle line, presents from the front behind, at first, a small cavity, in which the mystyform muscle is inserted, and which is directed outwardly by the projection made by the alveolus of the canine tooth; afterwards, another cavity, of greater depth, called the canine cavity, surmounted by the orifice of the suborbital canal; finally, further behind, a vertical top that separates the canine cavity from the maxillary tuberosity; this, evidently more projecting before than after the appearance of the wisdom tooth, is deepened by small conduits for the passage of the vessels and posterior and superior dental nerves. The anterior

part of this face corresponds directly in front to the upper lip, and at the sides to the soft parts which constitute the thickness of the cheeks.

Of the other two faces of the upper jaw, the upper one, which is of less extent, forms almost the whole of the orbit; the other, which is called *naso-palatine*, is itself divided in two unequal parts, one of which, situated above, larger behind than in front, forms a part of the platform of the nasal bones; and the other, situated below, forms a part of the palatine arch, to which we will shortly advert. It is in this part of the internal face that is seen the orifice of the maxillary sinus, a large orifice upon an isolated bone, and which, upon an articulated bone, is straitened by the prolongations belonging to the neighboring bones. This orifice leads to the interior of a cavity called maxillary sinus.

This cavity, which makes the bone we are speaking of very light, considering its bulk, has the form of a pyramid, of which the basis corresponds inwardly, the summit outwardly, the upper partition to the platform of the orbit, the anterior to the canine cavity, and the posterior to the maxillary tuberosity. If the extreme thinness of the upper wall explains to the surgeon dentist the influence of tumors developed in the sinus, on the condition of the organs contained in the orbitary cavity, the small thickness of the partition which separates below the bottom of the alveolus from its cavity, should also admonish the surgeon dentist that they can be easily penetrated by these alveoli, particularly by that of the canine, in perforating it to place a tooth on the pivot.

Of the three borders of the upper jaw, the anterior, in uniting with its mate, forms the projecting line that is seen between the two central incisors; the posterior vertical is very thick, but less so than the inferior or alveolar, which is the firmest part of the bone of which it forms in a measure the basis.

With this difference from the upper jaw, the lower jaw is composed of a single bone. This bone which occupies the lower part of the face, has the form of a parabolical curve upon both extremities, which are called branches, form a right angle with the central part called body. This body represents a bent

plate, convex in front, concave behind. Its anterior face offers to the middle part a vertical line, called symphysis of the chin; it is the mark of union of the two parts of which this bone is composed in young persons. This union is characterised in a man by the form of an arc instead of an angle;* and again, by a vertical line instead of an oblique direction behind and almost horizontal; thus, the chin is an exclusive attribute of the human species. The symphysis terminates in front by a triangular eminence, called mental, whence proceeds a line obliquely directed above to continue with the anterior border of the branch of the jaw.

The posterior face of the lower maxillary is moulded in some way upon the tongue; it presents like the anterior an oblique line which is directed equally behind and above, and becomes more projecting at the level of the last molar; beneath this line is a large depression, but one that is rather superficial, which contains the submaxillary gland, and above a cavity that receives the sublingual gland. The two oblique external glands, together with the oblique internal, divide the body of the maxillary bone in two parts, one superior or alveolar, the other inferior or basilar. The first constitutes, almost by itself, the body of the bone in the fœtus and in the child; but it only forms the two-thirds of its height in an adult, whereas it disappears almost entirely in old age, when this body is, in a great measure, reduced to its basilar portion.

The branches of the lower jaw are quadrilateral. Their external face is covered by the masseter muscle, which is its principal mover; the internal connects with the pterygoid muscle, and presents the orifice widened by the lower dental canal. But what is of importance to us to know and appreciate is the union of these branches with the body of the bone. The angle

* But it does not follow that this character will be exclusive to the human race, as many anatomists have said, for it belongs to many animals; the ape, a large number of dogs, the cat, lion, and many others, have evidently the inferior jaw arched, in such a manner that if an anterior part of the lower jaw being found angular, one might affirm that it never belonged to man; it would be imprudent to conclude the contrary, for the simple reason that the two parts which compose it unite and form an arch.

that results from this union, and which is called angle of the jaw, is extremely obtuse in a child; it becomes completely straight in the adult, and reassumes in old persons the aperture it has in a child, not by the retrocession of the articular condyle, which, forming the centre of the movements of the jaw, remains invariably fixed in the cavity that is peculiar to it, but by the progress of the body of the bone. It is this progress which, joined to the alveoli, explains why it is that the chin of old persons is so projecting.*

This variation of the body of the jaw and of its branches, determined by age, proceeds simply from the fact that at both extremes of life the two jaws intending to touch each other, it was necessary that their branches and their bodies should be almost on the same line, whereas, in the adult, the branches should raise each other in order to remove the jaws from each other, and of leaving between them the interval necessary to the teeth. Hence arise, 1st, the repugnance adults have for eating, those who have no teeth I mean. 2d. The impossibility of placing a set of teeth in the mouth of a child, and the precautions we should use in placing one in the mouth of an old man, whose jaw has followed its natural evolution.

Examined in their mutual relations, the two jaws present each, under the form of a parabolical curve, an alveolar border, in which are placed the teeth that seem to connect with it, and show themselves by exterior projections that give to this border a festooned appearance. The upper curve is greater than the corresponding alveolar curve of the lower maxillary bone, and we have already seen what the consequence has been for the mutual disposition of the teeth in both jaws. Each of these borders, less thick in front than behind, where it projects inwardly, is surrounded by a series of holes, separated by their partitions. These are the alveoli, whose dimensions are proportioned to the roots they should contain, and which are subdivided like roots into two, three or four secondary cavities.

In the upper jaw, the bottom of these alveoli approximate the

* Bichat has erred, as M. Serres very judiciously remarks, in saying that the branch of the inferior jaw inclines as much more from the perpendicular as we observe in more advanced age.

maxillary sinus, from which they are separated only by a bony partition of extreme thinness, and in which they sometimes open: this is principally applicable to the canine teeth. On the upper alveolar border, principally in front, we can observe projections that correspond to the alveolus, and depressions that correspond also to the interalveolar partitions. At the moment of birth, the upper maxillary bone, which then is not very high, is specially formed by the alveolar range that contains the germs of the teeth, and are almost contiguous to the *platform* of the orbit.

As to the border of the lower jaw, it begins to exhibit itself at a period very near conception. The alveolar borders of each jaw subsist, in the course of life, on the important changes that arise from the eruption of the teeth of first and second dentition, and afterwards from the fall of teeth in old men; a fall that causes quite a decrease in their height.

Examined in the skeleton of an adult, the alveoli have, in general, a conical form, and are moulded exactly on the roots of the teeth for which they are destined. Their aperture is necessarily directed upwards, in the lower jaw, and below in the upper; their bottom is pierced with holes that communicate with the dental conduit, and that serve to transmit to the follicle of the tooth, the nervous and vascular pedicle intended for it; the thickness of their partitions differs according to the species of teeth which each one of them contains. Thus the incisors of the upper jaw have alveoli thinner than those of the other teeth; those of the canines are stronger, thicker and deeper than those of the incisors, and even of the small molars; the first large molar has alveoli stronger than those of the second and last, or wisdom teeth.

In the incisors of the lower jaw, there is a similar disposition, and it is this that makes these teeth yield more easily to the blows they receive, and they also yield more easily to the efforts of the operator who extracts them. The alveolus of the first large molar, is not as strong as that of the second and third. The wisdom tooth, on the contrary, in the lower jaw, presents the strongest and thickest alveolus of all, because it is found deepened in the thickness of the coronoid apophysis.

It is, moreover, useless to observe, that the alveoli are pre-

cisely in proportion as to capacity to the teeth for which they are intended, and that, consequently, small for the incisors, a little larger for the canine ; they acquire their summum of development in the region of the large molars.

The partitions of the follicles of the teeth are confounded outwardly with the periosteum of the alveoli which forms the principal means of union of the teeth with the alveolar process in the normal state ; union, whose intimacy causes the resistance and the principal strength of the teeth. It must not, however, be disowned, that this union is powerfully seconded by the perpendicular pressure which the teeth exercise towards each other, when the jaws are approximated : the proof of this action is acquired by the apparent elongation of each tooth, when the opposite one is missing, which very commonly occurs. There is, in this case, a simple eccentric motion of the tooth, but not a real increase in length. This last phenomenon is observed in certain animals, and not in man.*

It sometimes happens that the teeth are retained in their alveoli much more solidly than we have just stated, from the fact of a particular arrangement of which we have spoken, in treating of the molar teeth. In effect, the summit of the cone of the roots may be bent in form of a hook, and fixed upon a projection from the bottom of the alveoli. The roots of the alveoli, as we well know, can likewise be strongly diverging, and form, in this way, a sort of nipper, with bended points, and adhering to the line. Finally, by an entirely contrary arrangement, the roots of the same molar teeth are occasionally convergent, and intercept, completely, a bony portion that seems to be connected with them.

When a tooth has been withdrawn from the alveoli that contained it, this cavity soon sinks, so that it is no longer possible, after a certain period, to discover any vestige of it. And in effecting the occlusion of this cavity, not only does the alveolar border sink, but also the bottom of the alveoli rises a little.†

* See Memoir of M. Oudet, published in 1823, upon the Continued Growth and Reproduction of the Teeth of Rabbits. We shall soon have to refer again to this memoir, and to the phenomena to which it is devoted.

† This fact is rendered evident by the prompt extraction, in certain cases, of dead teeth placed in alveoli recently empty.

In the jaws of new born infants, the alveoli have not yet attained their development; there are ten or twelve in each jaw; they are very small, not very deep; formed by partitions extremely thin, and presenting to the exterior as many platings. Each alveoli contains a dental germ.

Hence it follows that the alveoli serve to fix the teeth, and furnish them with the requisite solidity to accomplish the action of mastication, and to resist exterior violence. Their method of union with the teeth, is unique in their organization: it is not an articulation, but a simple implantation.

Summary Anatomy of the Gums.

However solidly fixed the teeth may appear by the juxta position of the alveolus around their roots and their neck, nature has thought proper to increase the firmness by a fibro cellular tissue, sufficiently thick, that covers both faces of the alveolar borders, and even penetrates into the alveolus.

To this tissue is given the name of *gum*. Anatomists appear to see in it but a portion of the mucous membrane, which is distinguished by its intimate adherence to the periosteum by its thickness, and principally by a coriaceous density, almost cartilaginous, a density that enables it to resist the contact of hard bodies subjected to mastication. No doubt, then, that the gums have much analogy with the portion of the palatinal membrane which is near to them. They are arranged thus:

They commence at about two or three millimetres—a line or a line and a half—from the basis of the alveoli, where their limits are marked by a relief of festooned appearance. Having reached the free border, or the basis of the alveoli, they continue their passage in the space of two millimetres, as far as the neck of the tooth. There they reflect upon themselves, and the precise place where this reflection is effected is a free semilunar border, imitating the indented border represented by the bases of the alveoli. Those slight slopes correspond to the intervals of the teeth between which the portion of gum which the anterior face of the alveolus communicate with that which lines the posterior face.

The reflected portion of the gum corresponds, without adhering to it, to the root of the tooth in all the parts of this root which grows over the alveolus, then sinks into it to constitute the dental alveolar periosteum, which we know is a powerful means of union between the root and the alveolus.

The tissue of the gum, firm and elastic, presents a color of pale vermillion. It appears furnished with follicles, but which we persist in believing foreign to the formation of tartar. It varies much in color and density, according to individuals. One of its most marked characters consists in the special action exercised over it by scorbutus and mercury, under the influence of which it softens and become spongy and bloody.

Another character of this tissue, but one that is entirely anatomical, consists in apertures very much developed, which are seen by a naked eye on a fine day. Almost insensible when divided by a sharp instrument, it nevertheless creates serious accidents when under the influence of the pressure exercised by the teeth.

The tissue of the gum contains very little cellular tissue, properly so called. It is, however, susceptible of being easily swallowed by delicate women, and also by lymphatic individuals, and all persons who dwell in low, damp places; this indicates a great permeability. Furnished with capillary vessels sufficiently developed, which, by the pressure of the finger, causes it to experience the discoloration of erysipelas in sanguine and vigorous individuals, and to preserve the clammy depression of the oedema in those who are weak and cachectic; this tissue forms at the neck of each tooth a small pad, whose thickness depends on the robust health of the individual.

In subjecting the gums to a convenient maceration, we perceive in their tissue three layers or distinct membranes. The mucous membrane forms the first, at the same time that it continues in the digestive apparel. Afterwards, a sort of pulpy substance is detached, which composes the second layer; and finally we perceive that the third is entirely distinct from the others, by its tissue, which appears of a fibrous nature.

This last tissue is prolonged as far as the interior of the alveoli, and forms in it sacs or matrices of teeth which are found her-

metically closed by the pulpy substance, which is placed over them. It is then also accompanied by the mucous or first layer, which is introduced between it and the collar of the teeth and gives birth to the generating pulp of the teeth, as the skin forms that of the nails and hair.

The fibrous tissue, of which we have been speaking, is very probably that indicated by Bichat, in saying that in the fœtus, and before the eruption of the teeth, the double border is covered with a particular tissue, very thick and very firm, that this tissue covers the alveoli and exactly obliterates them, as well as the dental germs which they enclose. It is undoubtedly this tissue that Serres and Meckel* have described by the name of dental cartilage, and whose destruction takes place at the first dentition. But how can we reconcile this opinion with what happens in the old man after the loss of his teeth.

Does this pretended cartilage reappear then? or do the gums return to the condition in which they were in early infancy? This last opinion seems to us most admissible.

Independent of all that has been written on the organization of the gums, it must be admitted that this part of anatomy has not been as fully investigated as it might be, and that the researches hitherto made on this subject have not been as clear and precise as might be desired.

To complete the anatomical history of the dental apparel, considered in a general way, it now remains for us to give a description of the nerves, arteries and veins that lead to the three parts of this apparel.

Nerves and Vessels of the Dental Apparel.

Nerves.—The nerves that are distributed in the teeth and jaws are supplied by the fifth pair of the nerves of the skull, generally known by the name of trigemini. The upper teeth and the upper jaw receive theirs from the second branch of these nerves, or the middle branch of the upper maxillary. They are the posterior dental alveolar, and the anterior dental alveolar.

* *Manual of General and Descriptive Anatomy*, translated 1823, by Bichat and Jourdain.

The first two, sometimes three in number, are detached from the upper maxillary, sometimes by a common trunk, sometimes alone, when about to connect with the suborbital canal are forced in front and below, furnish fillets, which are distributed into the muscles of the face and the tissue of the cheeks and gums. They are afterwards received into canals made in the thickness of the maxillary tuberosity, and then present themselves under the appearance of small ribbons; one of these branches, known by the name of superior posterior-dental, crosses the basis of the maxillary tuberosity and joins the level of the canine fosse by a fillet provided by the anterior dental; it gives several fillets that pierce the substance of the bone to furnish the roots of the three or four last molars. The posterior inferior dental, stronger than the superior, crosses a crooked passage under the maxillary tuberosity and joins at the level of the canine fosse, to the posterior superior dental. From their reunion arises a great number of fillets, which form a considerable quantity of networks; the fillets coming from these networks are included in the thickness of the bone, but nearer the internal surface of the sinus than the external surface of the maxillary bone; they furnish filaments that are extremely thin, and which enter the small molars.

The anterior dental alveolar arises very large, from the upper maxillary a little before it leaves the suborbital canal. It afterwards enters a canal provided by the upper maxillary to be reflected on the platform of the nasal bones. Having arrived at the level of this base, about a millimetre from the orifice, it spreads out in a great number of fillets, some of which go up, others descend. The latter reflect from below upwards in the thickness of the front nasal bone, where they disappear; the first terminate in providing the incisors with dental nerves, also the canine and even the first small molar. Many fillets also disappear in the thickness of the bone.

The lower teeth and lower jaw receive their nerves from the lower maxillary, the strongest and deepest portion of the three branches of the fifth pair. This nerve is forced outwardly and a little in front, leaves the cranium by the round hole which bears its zygomatic fosse, where it instantly divides in seven branches—of these branches, three are external: the temporal

profound, the masseterien, and the buccal, one is internal, which is the pterygoidian; finally, two are inferior, the lingual and the dental inferior, which is the true termination of the lower maxillary. We will here treat of the lower dental.

This nerve more voluminous than the lingual, is positively to the lower jaw what the portion of the maxillary nerve, known by the name of suborbital nerve, is to the upper. It descends with the lingual between the internal pterygoidian and the branch of the lower jaw; it afterwards connects with the dental canal, which it crosses with the dental nerve, and furnishes in this passage a filament to each root of the large and small molars. Having arrived at the level of the hole of the chin, it separates in two branches—one is called mental, the other incisor. The first being considered, on account of its bulk, as a continuation of the upper dental, leaves the hole of the chin and spreads out in diverging fillets, which act in respect to the lower lip like the suborbital in relation to the upper. The second, extremely thin, follows the first passage of the lower dental, and divides for the purpose of supplying the canine and the two incisors.

As to the gums, independently of the nerves furnished them by the upper and lower dentals, they also receive them from the palatine, facial, and ganglion naso-palatine, discovered in 1815, by Hyppolite Cloquet.

Vessels.—The arteries of the dental system go regularly with the nerves, and come from the internal maxillary. Those that repair to the teeth and upper jaw are the alveolar or dental, and the suborbital which proceed with the buccal to the deep anterior temporal, at the level of the maxillary tuberosity.

The first being forced very flexibly in front and below, is divided into many branches; they are the gencival and periostic branches, which, having arrived at the basis of the alveoli, reflect around this basis to insinuate itself into their cavity and to be distributed in their periosteum; then the posterior dental branches, which are connected with the small dental canals, penetrate into the alveoli of the molar, large or small, and divide into as many small branches as there are roots. The second, which sometimes proceeds from a common trunk with the alveolar, connects with the suborbital canal, and leaves it for the pur-

pose of spreading out in a great number of branches, many of which penetrate into the gums, and thence into the alveoli of the canines and incisors. While advancing, it gives two branches, one of which is the orbitary, the other the dental. This last connects afterwards with the dental passage to furnish the canines and the incisors into which they penetrate, by the summit of the root.

The arteries that are distributed to the teeth and lower jaw are as numerous as those that the internal maxillary furnishes to the level of the condyle : they spring from the lower dental. It is well known that at its birth this artery is forced downwards, then approximates to the upper orifice of the dental canal, crosses this canal, accompanied by the nerve of the same name, and having reached the small molar, divides into two branches, the one mental, which comes from the hole of the chin, the other incisor, that continues its passage and goes under the canine and incisor teeth to disappear in the bone. In advancing, the dental artery as well as its incisive divisions, furnishes the roots of the corresponding teeth with dental branches. These branches penetrate at first into the alveolus, and then into the tooth by the summit of the tooth.

Finally, the veins of the teeth follow the direction of the arteries ; only the one that comes from the teeth and the lower jaw has its particular canal under that which protects the artery. As to the lymphatic vessels, their excessive thinness when they reach the jaw, prevents us from following them into the teeth, but there is no doubt that they penetrate the teeth, and join the nerves, arteries and veins to form the nervous vascular fascia, which constitutes in the canal of the tooth the kernel of its central pulp.

Such are the most prominent anatomical characters of the three principal organs of the dental apparel. Having only seen what bears upon our speciality, we have passed over many details of which the application to art by the dentist is not direct, we have even indicated certain bodies, such as follicles, and the dental pulp, of which a knowledge is considerably important. We have reserved them for the next chapter, because a description of them can only serve to explain the physiological phenomena to

which this chapter is devoted, and again, because this description is remote from the purpose before us.

Let us, however, observe, before entering upon the subject of the development of the teeth, that if we were desirous of drawing from the anatomical characters we have assigned to the dental apparel, inductions calculated to designate the sort of food nature has intended for the constant use of man, we would feel constrained to admit that it is both vegetable and flesh. But is there an equal inclination to use the one as the other? this is a question authors have differently answered. Some, as Grimaud,* deducing their opinion rather from the powers that cause the dental apparel to move, than from the condition itself of the apparel, compare the strength of the masticating muscles of man to that of other animals, and believe they are justifiable in concluding that man is fonder of flesh food than vegetable; they, on the other side, leaving aside all anatomical appreciation, refer only to facts, and maintain that as many sects of philosophers, and many tribes of Indians have completely abstained from meat, that vegetable food is most proper for our organization.

These opinions are both far from the truth. Broussonet, considering that as man has in all thirty-two teeth, twelve of which are incisors and twelve canine, that belong principally to carnivorous animals, whereas the remaining twenty are a more special attribute of the vegetable species; and then estimating man's disposition for food, divides unequally this tendency for animal or vegetable food, accordingly, $\frac{1}{3}\frac{2}{2}$ to the inclination to animal substances, and $\frac{2}{3}\frac{0}{2}$ to that of the vegetable; so that the question placed in equation gives for result that the want of vegetable food is to the desire of animal as 20 is to 12.†

We adopt readily this simple, just and spiritual way of solving the question, at the same time making all allowance for the many modifications that climate, habit, and constitution causes the human system necessarily to undergo.

* *Complete Course of Physiology*; Montpellier, 1818.

† See the new edition of *Elements of Physiology*, by Richeraud, vol. 1.

CHAPTER II.

PHYSIOLOGICAL HISTORY OF THE DENTAL APPARATUS. DEVELOPMENT OF THE TEETH, OR DENTITION.

THE study of the development of the teeth is truly one of the most interesting parts of their history. It embraces the description of the phenomena which precede, accompany and follow it: first, the cutting of the teeth of first dentition; secondly, that of second dentition. It supposes, necessarily, correct views, as well upon the development of the follicles and of the bony portion, as upon the growth and cutting of the teeth. These different points we shall successively treat of.

Dental Follicles.

We have already said that the teeth are the products of a true secretion, bearing the same relation to the mucous system as the various productions are to the skin upon the surface of which they are observed. Hence they are necessarily preceded by organs destined for their formation. These organs, equaling the teeth in number, and contained within the jaws, are the *dental follicles*.

On examination of the jaws of a fœtus of two or three months old, we discover that they contain long and deep gutters, divided into as many cells as there are germs of teeth. This groove is covered, on its superior surface, by the membrane of the gum, surmounted by a thin crest, of a fibrous nature, which is called, by some authors, dental cartilage, but only developed at the alveolus; the fibrous tissue of the gums sends into each alveolus a prolongation, (alveolo-dental periosteum,) which forms for each follicle a mucous sac, perforated at the bottom of the socket, through which pass dental vessels and nerves.

It is in this membranous fold which the gum forms, that are lodged little bodies called follicles or dental germs, representing round sacs, attached to the gums superiorly, and inferiorly to a vascular and nervous pedicle, which runs along the bottom of the alveolar groove. This follicle is formed of one, and not two

membranes, as some modern authors suppose, as Hunter, Blake,* Bichat, Cuvier and M. Delabarre, who have undoubtedly mistaken the alveolo-dental periosteum, or the prolongation of the gummy membrane, for the external membrane of the follicle; which makes an essential difference, as we shall soon see.

This single membrane of the follicle represents a closed sac, and seems to bear the same resemblance to the different papillæ, as the serous membranes do in relation to the organs which they surround, that is to say, after having covered the gummy fibrous sac, which lines the alveoli, the follicular membrane is reflected upon the vessels and nerves which form the pedicle of the pulp, and appears to be a prolongation of the same. This membrane is free and smooth upon its internal surface, and adhering externally; it is generally thin, transparent and very vascular; its vessels and nerves are supplied from the pedicle of the dental follicle and not from the trunks diffused in the mucous membrane.

From the foregoing, we perceive that the dental vessels and nerves form two distinct systems; one for the exterior of the follicle, the other for the part contained in the dental cavity. The first has its origin immediately from the vascular and nervous system of the buccal membrane, the other supplies special organs, (as the internal maxillary artery and the trifacial nerve.) The different pathological conditions of the teeth give daily proof of the distinction which we have just made, and upon which anatomists, according to our opinion, have not sufficiently enlarged.

The true membrane of the follicle encloses a transparent and viscous liquid, like synovia, containing light flakes, which give it the consistence of mucilage. It diminishes, in respect to quantity, from the time of its first appearance until the eruption of the tooth, at which period it disappears.

The office of the membrane proper is the secretion of the enamel; it has only a temporary existence, which is no longer than the period necessary for the accomplishment of its functions. Blake has treated of it under the name of the caducous membrane.

This function of the membrane proper has been defined espe-

* Work quoted.

cially in the numerous researches of Herissant. If we carefully detach, says this learned physiologist, this membrane above the crown, and examine its interior surface immediately with a magnifying glass of six or eight millimetres (three to four degrees) of focus, we will instantly be struck with admiration at the appearance of an infinite number of small vesicles, which, by their transparency, resemble those by which the *ice-plant* is covered; they are arranged in regular rows, one upon another, and which are, for the most part, parallel with the base of the tooth.

These vesicles contain at a certain period a very clear and limpid liquid, which afterwards becomes thick and of a milky appearance. We cannot mistake the use of this liquid; it is evident that when it is spread over the part for which it is destined, and when it has all the necessary consistency, the tooth will be clothed with a coat of enamel of great brilliancy. Its irregular productions produce anomalies, of which we have spoken, and of which we possess many specimens. Messrs. Rousseau, Desmoulins and Cruveilhier have confirmed by their own experience the opinion of Herissant upon vesicular projections of the free face of the follicular membrane.

The Pulp or Dental Papilla.

We have already said that the membrane of the follicle contains only a transparent fluid, afterwards viscous and then slightly yellowish white. But near the third month (of foetal existence) a little body makes its appearance, which, in the form of a papilla, rises from the bottom of the socket. This vascular and nervous papilla becomes gradually more firm, and of greater dimension. It is at first of a gelatinous consistency, and from its physical characteristics, bears some analogy to a nervous ganglion. Its exterior surface is thin, membranous, and moistened by a liquid which it imbibes and transudes.

From what we have said of the anatomy of the part, it is difficult to ascertain precisely from what these little bodies derive their organization; the only thing well defined in this respect, is, that they are formed by the termination and expansion of the

dental nerves and vessels, and that these two organic elements are here united in equal proportions. They are also the seat of very energetic, vital action, which creates in these germs the sensitive and living parts of the teeth. A very thin pedicle, formed by the dental vessels and nerves, is the means of union to that papilla which is there found suspended like the seed of a grape.

The papilla is necessarily bathed for a time in the liquid which the sac contains and which diminishes in quantity as the papilla enlarges. In its more advanced stage the papilla acquires an increased consistency; elongates, assumes its destined form, and gradually acquires the volume and form of the future tooth, of which it is an exact image, and to the secretion of which it ought to assist. The crown is the part first formed upon the papilla, for we there find all the depressions and eminences which the tooth afterwards exhibits.

Development of the Follicles.

We have already shown that the follicular membranes were of the various rudimentary parts of the tooth, those which formed the first. We have seen from the beginning, that they are united in such a manner to the gums, that in exercising a slight pressure upon the latter that they rise with them, as also do their vessels and nerves.

But, although the follicles of the apparatus of both dentitions exists at the same time in the jaws of the fœtus, as M. Serres has correctly proved, these follicles are not formed at the same time and do not present the same characteristics. About the middle of the third month of fœtal life, we discover upon each half of the two jaws, four sacs, each of the two anterior and posterior pulps press against each other, leaving a sufficient space between the two pairs. The first follicles, which are the smallest, represent the temporary incisors, the two latter are the temporary molars. At the end of the third month, in the middle, but somewhat anterior to the space of which we have spoken, there is seen a marked projection of the external plate of the alveolar ridge, which contains a fifth sac—it is the canine tooth. These constitute the complement of the follicles of first dentition.

The follicles or germs of second dentition correspond with the arrangement of teeth already formed, being separated from them by bony partitions. The following is the relation which we have discovered these pulps to bear to the follicles of the teeth of first dentition: first, the follicles of second dentition, that is the three last molars, are upon the same arch with those of the milk teeth, but occupying the lateral extremities of it; second, the follicles of the teeth of replacement, on the contrary, are placed precisely in the rear of their corresponding deciduous teeth.

These follicles are at first contained in the same alveoli that the temporary teeth are; it is only after a certain lapse of time that they become gradually separated from them by a bony partition, which, at first fibrous, rises from the bottom of the alveolar groove, and finally ossifies. A long time, however, after the formation of this bony partition, the temporary and permanent alveoli communicate by an opening sufficiently large for the passage of a small cord which joins the two teeth. We shall now show the order in which the follicles of second dentition appear.

About the end of the fourth month, we discover the sixth sac at the bottom of the groove of the jaws. This is the sac of the first permanent molar tooth; it generally precedes the others several months. It is only until about the middle of the seventh month that we can discover the capsules of the permanent incisors. At a later period the capsules of the canine and second molar teeth are developed. With regard to the follicles of the wisdom teeth, although some authors have pretended to discover them in the form of ganglions at birth, they are not, however, to be seen at that period; we can affirm that this is always the case; moreover, in admitting with M. Serres, the existence of the follicles of the bicuspides or small permanent molars, in the fœtus, we must avow that we have never found them excepting in infants of eighteen or twenty months old.

Thus far we have been treating upon the organs destined for the formation of the teeth; now let us inquire what are the phenomena of their formation.

Development of Dental Bone.

If physiologists generally at the present day admitted that, soon after the appearance of the follicle the tooth begins to develop itself in it, that is to say, such as are most precocious, about the third month of intra-uterine existence, they also agree that the formation of the teeth takes place in the interior of the follicle; but they are far from agreeing upon the precise point at which the first deposit of the bone takes place. Cuvier contends that this takes place between the papilla and the proper membrane of the follicle which is reflected upon and entirely surrounds it; others contend, that this deposition of calcareous matter takes place within the cavity of the membrane proper.

Be this as it may, it is the crown of the tooth, particularly the cuspid part or summit which is first ossified. The process of ossification is preceded by a red circle which is situated around the summit of the papilla; the production of ossific matter now commences and is the result of a true secretion. Upon the prominent points which, at a later period, become the cuspides of the tooth, we observe very fine little scales forming, which encase the tubercles of the papilla; these scales, at first yielding, become gradually stronger, and correspond in number to the prominences of the dental pulp.

Hence these scales constitute as many points of dental formation, agreeing with reason, with the number of points of ossification of the bone. Thus, for the incisors, there are three points, according to Hunter; one, on the other hand, according to Albinus, Blake and Meckel, and the same for the canines; but the molars have as many points of ossification as there are prominences upon the pulp.

We have consulted numerous researches to determine this physiological subject, and we have constantly concluded that there is but one very small scale for the incisor teeth. This scale, occupying the free border of the dental papilla, is always more prominent in the middle than at the sides; this fact leads us to believe that this might have been the result of the union of

three solid points which were organized at the same time. This appears plausible to us as the free edge of the incisors of children presents these marked depressions. As to the canines, we never could discover but one solid scale.

We have always discovered in the small molars, two points of ossification, each of which assumes the form of that which characterises the prominence of the crown, or in other words, it represents a small triangular and pointed pyramid. From this arrangement, and from the isolation which exists at a certain period between the various points of ossification at the crown, we may regard the molars as a reunion of several canines. Lastly, the large molars are always developed by as many points of ossification as there are tubercles.

The small scales, of which we have spoken, gradually enlarge—meet each other—unite, and embrace closely the extremity of the pulp, upon which it forms a case, and represents externally its form, so that we cannot detach it without injury, although the internal surface is as smooth as the external. When all these little scales are united, we then see the grinding surface of the crown. The process of solidification takes place in the inferior jaw before we see any point of ossification in the superior.

There is one question of importance yet to solve: it is the formation of the ivory and enamel of the tooth.

There are two opinions upon these points. According to Jourdain,* Auzebi,† and at a later period Rousseau, the enamel is secreted before the ivory; in the meantime, we must acknowledge, that those who entertain the contrary opinion are the most numerous; and, moreover, in opposition to these two opinions, Cuvier says that he has seen the bone and enamel appear nearly at the same time. Before declaring our manner of accounting for the formation of these two substances, let us examine, for a short time, hypotheses, more or less ingenious, which have been set forth relative to the production of this formation.

* *New Elements of Odontologia.* Paris, 1736.

† *Principles of Odontologia, &c.* Lyons, 1772.

Formation of Ivory.

For a long time anatomists entertained the opinion that the papilla underwent an osseous transformation, and that the ivory was formed from this by a progressive metamorphosis of its tissue. The diminution of the size of the papilla in proportion as the tooth acquires greater thickness, the gradual retraction of the dental cavity, and its entire obliteration in some old persons, gives a certain plausibility to that theory which, however, evaporates at the moment of its investigation.

Indeed, it is only necessary to examine the rudimentary tooth, to discover that it is simply placed above the papilla without adhering at all to its surface, which could not certainly be the case if the papilla became ossified. Cuvier, and others since his time, relying upon the analogy of the nail, and its matrix upon the one hand, and the feather and its papilla on the other hand, have proved, although after Hunter, that the ivory is secreted immediately by the dental papilla.

When all the points of ossification, which we have seen situated upon the surface of the papilla, are united in such a manner as to cover it completely, they present a bony horn, which gradually extends from the circumference of the vascular and nervous pedicle, to the point where this pedicle penetrates the alveolus. The exterior bone being formed, a second is formed within it, then a third is encased within this last; thus, in turns, they are formed. This growth, which is limited to the period of the complete development of the roots, takes place, as we perceive, from without inwardly, or from the circumference to the centre. Once produced, the ivory is no longer subject to remarkable changes; its durability depends more upon the apposition of the layers upon one another, than upon the modification which is produced in its texture.

Formation of Enamel.

The history of the secretion of the enamel is more complicated than that of the ivory.

It is said that the enamel, like ivory, is the result of the secretion of the pulp, which product oozes through the different

layers of the ivory for the purpose of solidifying upon its surface. M. Delabarre especially entertains this opinion, which the following phrase will refute. If the enamel is secreted by the pulp, the disc commencing the ossification which, successively, should form the crown, will be entirely composed of it; or this substance does not exist there still, hence the enamel is not the production of the pulp.

Other anatomists, as Bertin and Hunter, have contended, that the enamel is secreted by the membrane proper of the follicle, which remains in a state of dissolution in the liquid of this follicle until the formation of the crown, and then it forms crystals upon the internal surface of the crown. Hunter makes use of an ingenious comparison to demonstrate the crystallization of the enamel; he says that it resembles the deposits of salt of urine deposited upon bodies found in the bladder.

That opinion is not absolutely incontestable; nevertheless, it seems generally admitted at the present day. Cuvier entertains this opinion, with this difference only, that the enamel instead of being deposited immediately upon the crown, forms upon the portion of the internal face of the follicle which covers the crown. In this manner he accounts for the greyish line which always exists, as we have stated in the anatomical part of this work, between the ivory and enamel, and which is nothing more than this seared leaf between these two substances.

The enamel is soft and of a cartilaginous consistency at the time of its formation; it is of a dull white and is distributed in drops, which are at first spread upon the first layers of the ivory, afterwards upon the succeeding layers. In the fœtus we can separate it easily from the bony matter; we then discover that it is thicker upon the prominences of the crown than in other parts, and it becomes extremely thin as it approaches the neck of the tooth. Hence, the deposition of enamel takes place in an opposite direction from the ivory, in other words it is deposited from within outwardly. Its secretion is only temporary; it is limited to the existence and to the functions of the membrane proper, and is necessary only to the production of the crown.

In admitting the theories of which we have spoken in regard to the formation of the ivory and enamel, it still remains to be

explained why the crown is the only part which is covered with enamel. Herissant is the only one, as we have already seen, who has suggested the means of solving this very difficult question, by stating that the part of the follicle corresponding to the crown, was furnished with glandules, whose functions were to secrete the enamel.

We should in truth say, that wishing to convince ourselves of this fact, we have several times discovered upon the surface of the leaf of the membrane proper, as far as the top of the crown, a kind of pulp resembling little white molicular globules. These little bodies were very few in number, nearly imperceptible and atrophoid when the enamel had been developed and was visible, while their number and size may be perfectly distinguished in those cases where the production of enamel had not yet commenced. We lay great stress upon this point, since it leads to the solution of this problem which has called forth so many theories, to wit: how does it happen that the enamel substance is deposited exclusively upon the crown.

Indeed, when the crown of the tooth is once covered with a layer of enamel, the leaf of the membrane, or at a later period the little corpuscles are atrophoid. It is then evident that the root, the development of which is later than that of the crown, has nothing in it in common with the enamel.

That opinion, which appears to us most reasonable, is still supported by the fact, that the teeth of animals which have not the follicular membrane are not covered with enamel; while in those, on the other hand, in which this membrane exists after the eruption of the teeth, the secretion of enamel continues after this eruption, as that of ivory. The incisive teeth of the rabbit, beaver, rat and other gnawing animals, are in this latter case, as we shall soon see in speaking of the growth of teeth.

In the meantime, we perceive from what we have already said upon the phenomena of the formation of the teeth before their eruption, that we can deduce the following consequences.

Of the two constituent parts of the tooth, to wit: the cortical or hard portion, and the pulp or medullary portion, this last is first developed; and of the two distinct elements of the hard portion, the ivory and enamel, the ivory is first formed.

The formation of the cortical substance of the tooth commences at the crown ; the roots are afterwards formed.

The pulp or papilla finding itself as it were enclosed in the midst of solid matter, in the formation of which it assists as much of itself as by its follicular membrane, and which gradually contracts its cavity, diminishes continually in size and finally entirely disappears.

In other respects we should frankly acknowledge that if moderns had prescribed facts upon which rests the theory of the development of the dental bone, they have found among the ancients the basis of that theory perfectly established. There are abundant proofs of this assertion. We content ourselves with the following one, extracted and translated from a German anatomist,* who wrote two hundred and fifty years ago, a period when anatomy was first brought to light : "The teeth are formed from a species of mucus, enclosed in the cavity of a follicle, they are developed like a rudimentary body, around which an incrustation is formed, differing in that respect (*longè diversæ*) from the formation of bone, which is effected through the medium of a cartilage (*per intercessionem cartilaginum,*) &c. &c."

THE GROWTH AND ERUPTION OF TEETH IN GENERAL.

The Growth.—When the bony covering is once formed around the pulp and envelopes it entirely, we may then soon see new layers under those first formed. These layers are at first more and more extended, in proportion as they are more distant from the period when the tooth first began to develope itself. At a later period they present an inverse tendency ; they are encased in the preceding ones ; they gradually raise them and push them from the pulp, which they soon embrace from the circumference to the base. The crown is now completely formed ; the enamel is deposited upon it as has been already stated ; and the process of evolution, after having undergone a delay, according to some authors, the process is renewed. New layers of ivory, products of the pulp, embrace it inferiorly, forming successive caps which by degrees encase each other ; they surround its pedicle, descend as far as its extremity and form the root.

* Valcherus Coiten, contemporain de Visale.

To depart from this epoch, says M. Blandin, the tooth has completed its growth in length; the bony layers which succeed can then no longer increase its bulk, and as it is always by an interior juxta-position that this growth takes place, the dental cavity gradually contracts, the pulp diminishes, and the circulation being confined in its vessels, its secretion abates and soon entirely ceases.

Here are limited the changes which the single rooted teeth undergo; but, the mechanism of such as have several roots is more complicated. Their ossification commences, as we have already said, in several points, representing as many little caps as the tooth has prominences or tuberosities upon its summit, and as the pulp presents elongations; for, in examining the inferior part of a germ, we perceive that the vessels which penetrate it are divided into two, three or four bundles, according as it is destined to form two, three or four roots. Blake and Fox,* ignorant of this fact, describe upon the pulp, bony angles, which divide the base of the crown into as many segments as it ought to have roots.

These caps are naturally convergent at their base; each increases at its side, by the addition of successive layers increasing as they approach the base. They soon meet each other, and all at once unite, those that are without with those that are within; from this time they form upon the superior part of the papilla only one great cap, undulated upon its surface, and the growth of which continues the same as if it was primitively developed at the same point. Finally, when the ossiform stock of the tooth has reached the union of the papilla with its pedicles, the calcareous matter is secreted at once around the body of the papilla and its pedicles; it encompasses each of them with a tubulous envelope, continues with this from the rest of the papilla, and the growth progresses finally as in cases of one point, with this difference only, that the osseous layers, instead of presenting a series of simple cones, are subdivided into as many additional hollow cones as the tooth should have roots.

"Thus, (continues M. Blandin, from whose work we have quoted,) the teeth increase from the summit of the crown to the

* Remarks upon Dentition; Guy's Hospital, London.

end of the root, and from the exterior inwardly; it is at once completed in length and thickness, by moulding itself upon the papilla, and embracing it accurately at every point."

Here arises another very important question: why is the growth of teeth in general, and especially those of man, confined to narrow and very limited spaces; or, in other words, what is it that impedes the growth of teeth? For the solution of this question, it is only necessary to recollect that the formation of ossiform substances being subordinate to the presence of the papilla, and that the growth of the ivory being effected in concentric layers, that is to say, from without inwardly, that the pulp, surrounded on all sides, and gradually constrained by them, it is necessarily more and more restricted, and in such a degree that its functions become arrested all at once, under the last long layers which it has removed. The growth of the tooth is now entirely completed.

That limited growth of the human teeth, whatever Fallopius may have said, and others since his time, who believed that they might have an indefinite increase, has been long since an incontestable fact noted by anatomists; but no one that we know of has ever before given a satisfactory explanation of it, not M. Oudet, as has been generally supposed, and as M. Blandin* has erroneously asserted; but before Dr. Francis Lavagna, of the Imperial Academy of Genoa, who, in a work published in 1812, consequently eleven years anterior to the memoir of M. Oudet, has demonstrated that it is exclusively to the pediculated form of the dental papilla that the human teeth should embrace that part entirely, gradually press upon it, then to destroy it by its pressure, and hence to arrest of itself its growth in length, by the death of the principal agent of vitality which the teeth possess.

Thus the incisors of the *rongeurs*, as the beaver, the hare, the rabbit, the rat, and so on, which possess the faculty of continually growing, and even to be reproduced after being broken, as the following phrase, printed more than two hundred years, proves: "*Quod si acutis forcipibus secantur, una tantum nocte renascuntur.*"† Thus the incisors of the *rongeurs* present a pa-

* Work previously quoted, page 101.

† Mathiole, Latin edition of 1674, page 299.

pilla, in conformation perfectly the reverse of that of the human teeth. That papilla is indeed unprovided with a pedicle; it is conical, and supported at the bottom of its follicle and the alveolus which encloses it, by the base of the cone which it represents. In this way it can continually secrete calcareous layers, without ever being embraced by the osseous walls of the dental canal, at the part whence it receives its vessels and nerves.

As we do not wish you to think that, by depriving M. Oudet of all the merit of the new idea which is the subject of his memoir upon the dentition of *rongeurs*, we cannot be deceived by the simple appearance of identity between his views and those of Dr. Lavagna, we will quote what this last writer says: * “The incisor teeth of *rongeurs*, at least those of the wolf, the hogs of India, and the mice that I have examined, are of the same thickness through their extent, and in this respect they are very different from the teeth of man, which have pointed roots. The cavity of the teeth of *rongeurs* differs still more from ours; from the body of the tooth to the extremity of the root, this cavity gradually enlarges in such a manner that the teeth, even in their roots, present a large cavity. * * * * This large cavity in the roots of the teeth must leave a free access to a great number of vessels, which, distributed through the substance of the tooth, must render it very compact and resisting. * * * * The teeth of man have, on the contrary, in their roots, so small a cavity, (*un forame sì picciolo*,) that blood-vessels, as it were invisible, can scarcely penetrate it, etc. etc.”

Writers generally have been so much at a loss to explain the growth of the human teeth and those of the inferior animals which are analogous to these, and to account for the constant prolongation and reproduction of the teeth of *rongeurs*, that they are content with the explanation of Lavagna, repeated by M. Oudet; but, in our opinion, the following question should have been put:

1. How is it that the occlusion of the hole of the roots of the

* His work is entitled, *Esperienze e riflessioni sopra la carie de' denti umani coll' aggiunta di un nuovo saggio su la riproduzione dei denti negli animali rosicanti*. The phrases quoted are extracts from pages 161 and 163.

human teeth should cease and leave an opening only just large enough for the passage of the nerves and vessels? 2. How does it happen that in man, the teeth, after they have ceased to grow, their interior cavity does not only still exist, but that the hole at the extremity of their root does still exist? 3. Finally, how does it happen that the cavity of a tooth which is exposed, becomes closed by the deposition of osseous matter, which would appear impossible if the functions of the pulp had entirely ceased? The foregoing remarks do not, assuredly, prevent us from adopting the explanation which we have already given—in the impossibility of which, we will substitute in the place of it another more reasonable.

Thus, what we know of the manner by which the growth of the calcareous portion of the teeth is effected, we are obliged to admit that it takes place by a simple juxta-position, and not by intus-susception, as is the case with other bones. The experiments of Hunter upon the nutrition of young animals with madder, establish these facts, since the teeth become red on the part that is forming during the time the animal is fed with this article.* Various pathological facts also prove this mode of growth, as we shall see when treating of the diseases of the dental follicles. We very often observe, indeed, upon the crowns of the teeth of certain individuals, prominent undulating transverse lines; sometimes we observe rough grooves or deep pits, which are nothing more than the effects of disease under which such individuals were laboring when children. They affect the whole bony structure of the tooth, as well as the enamel.†

We shall now bring our remarks upon the development and increase of the teeth to a close, by treating of the order which they follow in their solidification.

* This fact, however, has been recently contested by M. Flourens, secretary of the Academy of Sciences, who has shown that it is not only the part of the tooth whose formation is going on becomes colored when fed upon madder, but also such parts as had been previously formed. This necessarily presupposes a more complicated or more vital process than that of simple juxta-position.

† This is sometimes, but not always, the case, for it often happens that the enamel is the only part which sustains a direct or immediate injury.—*Trans.*

This process proceeds in the same manner as do the development of the follicles. The appearance of the first points is seen in the fœtus, between the fourth and fifth months, beginning with the central incisors, and those in the lower sooner than those in the upper jaw; the lateral incisors, and then the anterior molars are the next. At a later period these points appear upon the canines, and then upon the second small molars.

The solidification of the permanent teeth commences during the last month of gestation, in a small point upon the anterior and external tubercle of the first large molar. Sometimes, before the term of fœtal existence, there are three or four isolated points in place of the one just mentioned, which unite at the close of the first year. After the first large molar, the central incisor becomes ossified during the month after birth. Two months after this, the follicle of the lateral incisor is covered with a small scale; then, about the sixth or seventh month, the canine is discovered to be ossifying. It is not until about the third or fourth year that the formation of the bicuspid commences: these are followed by the second large molars. As to the third molar, or wisdom tooth, we have rarely seen it formed before between the ninth and tenth years. The following is the manner in which the teeth are cut.

The Eruption of the Teeth in General.

At birth, the temporary teeth, enclosed in the socket, present the following appearance: The crown of the middle inferior incisor is nearly completed; the superior is a little more tardy. The lateral incisor is later, especially that of the superior jaw. After these, the small anterior molars, the various isolated parts of the crown of these are now united; this gives them a large size, though they have not at this time acquired their full height. As for the canine and small posterior molars, the first of these present only the extremity of its crown, the second has the most of its parts separated from each other, and connected only by a very thin pedicle.

During the development of the teeth, changes are going on in the jaws; the partitions which separate the follicles are com-

pleted; the alveoli form and accurately mould themselves to the teeth; finally, the maxillary bones acquire volume in every part. The inferior jaw offers this exception, instead of having only one canal, it is traversed by two, which sometimes have each of their openings partially bifurcated; at other times only one; each of these canals contains an artery, one belonging to the teeth of first, the other to those of second dentition. The superior, if perceivable at the time of birth, gradually diminishes, and soon leaves only the vestige of its first existence; the inferior continues through life.

Be that as it may, it is no less true that if, at the time of birth, the teeth are very much developed, they still remain closed in the alveoli, and covered by the gums. Pliny, Columbus, Vanswieten, Donatus, Haller,* Sæmmering and Bandelocquet† of later date, quote many examples of children who have been born with teeth, (all the world know that such was the case with Louis XIV and Mirabeau;) but these are only exceptions, and it is well known that it is very rare for one or two teeth to be cut at birth.

The presence of teeth is perfectly useless to a child while it derives its nourishment from its mother, still the jaws need a certain firmness to support the efforts of sucking; nature, likewise, attentive to all the necessities which has nothing superfluous, has furnished both the alveolar borders, which are afterwards to be occupied with teeth, with a cartilaginous substance which we know has been called by many authors *dental cartilage*, and which diminishes as the eruption of the teeth approaches, and entirely disappears after they have come through.

But the child, a few months after its birth, not finding in milk, nourishment proportioned to its wants, and consequently being compelled to have recourse to more solid and more abundant food, it becomes indispensably necessary that at this time its maxillary apparel should be fortified with proper instruments for separating and chewing its aliment. This results from the ap-

* This learned physiologist mentions, in his *Elements of Physiology*, nineteen cases of children born with teeth.

† Traite d'Accouchements.

pearance of the teeth externally, which were before contained in the alveoli.

While these organs are developing and their roots increasing in length, the crown, yielding to a vital motion which forces the tooth outwardly, progresses in its alveolar cavity, removes from its bony partition, and reaching shortly the gum, appears through its tissue.

But what is the cause of this singular phenomena, true action of locomotion, in virtue of which the teeth advance in their alveoli, and removing the obstacles which oppose their egress, terminate by removing the enclosure in which they were enveloped? In a word, how and why do the teeth daily penetrate through the gum? A question assuredly simple, but the solution of which, however, has long since become an arena, upon which the makers of hypotheses have exercised a show, against which the sagacity of the most profound physiologists have fallen.

Some have thought that the eruption of the teeth could be explained by the pulsation of the arteries, others have believed that they could account for it by a struggling which exists between the vital force of the teeth and that of the gums, a struggling which would result to the advantage of the first; others again attribute this phenomena to the contraction of the alveoli.

As neither of these three hypotheses can stand the test of a critical examination, we have sought for a better explanation; it has also been said, that if the teeth pierce the gums, it is because their roots, in proportion as they elongate, press upon the bottom of the alveoli, which presents to them a firm resistance, forces the tooth through the gum, which, more yielding than the base of the socket, gives way to the efforts which the crown exerts against its interior parts, spreads itself, finally ruptures and permits the tooth to escape. This explanation has, at least, the merit of extreme simplicity; it has also deceived many physiologists; but we, who know that the membrane which lines the base of the alveoli is by far more sensitive, and consequently by far more irritable than the tissue of the gums, and moreover, incapable of offering the support necessary to the progression of the tooth, we are forced wholly to reject.

This assertion has something in it similar to that of those who admit that the eruption of the teeth is effected by the approximation of the alveolar walls and the elevation of the floor of the alveoli ; but this opinion is inadmissible, for the reason that the alveoli, on the one hand, narrow themselves transversely, and that on the other, they become deeper, as the teeth develop themselves.

M. Delabarre, moved without doubt by the desire, assuredly a praiseworthy one, of explaining the eruption of these organs by the laws which govern the other functions, has, so to speak, assimilated this phenomena to that of parturition, in declaring that the tooth forces itself out by the contraction of the internal membrane attached to its neck, as we know, a neck which is drawn towards the surface of the gum, and which, arriving there, can go no farther, because the contractile force of the membrane is exhausted.

This theory is assuredly very ingenious, but difficult to sustain, in truth, how can we suppose this excessively delicate membrane, which lines the follicle, is sufficiently powerful to force out a body like that of a tooth ?

Little satisfied with the explanation of M. Delabarre, Lemaire, who in all things aims at originality, pretends that when the body of the tooth is formed, the vessels which penetrate its cavity, being no longer charged with furnishing it with calcareous matter, take a new action and greater energy, whilst those which belong to the gum, carrying life to the capsule, become useless and obliterated ; then the body of the tooth, by the energy of its vessels and nerves, elevates itself in its alveolus, whose orifice distends to give it a free passage ; the roots form progressively ; the crown finds itself in immediate contact with the gum ; this latter permits itself to be penetrated, absorbed, and then passes through it without any other aid than the extensibility of the one and the contractility of the other.

There are two objections to the theory of Lemaire ; first, it will be committing an anatomical error to suppose that the borders of the alveoli enlarge of themselves for the purpose of opening a passage to the teeth : another objection is that the alveoli always show openings sufficiently large for the escape of the

teeth ; second, nothing proves that the vessels and nerves of the teeth at the time of their eruption have acquired an energy different from that which corresponds to the general progress of the whole economy. Whatever this energy may be, it explains only with difficulty the movement of the ascension of the inferior and the descension of the superior teeth.

Finally, M. Serres, fearing, doubtless, to add an hypothesis to those of his predecessors, contents himself with explaining the fact, by the fact itself, and he considers it as the result of a *primordial law*, analogous to that, in virtue of which the testicle passes, in the required time, from the abdominal region in the scrotum, or to that to which the fœtus obeys, when it breaks the envelopes which holds it to the uterus.

As prudent as M. Serres, perhaps more fortunate than himself, we content ourselves by saying that the opinion which appears to us the most plausible, and which is altogether confirmed by observation, is that which explains the cause of the passage of the teeth from their alveoli in the progress of their growth ; in other words, that the teeth depart from the alveoli because these last can no longer contain them, and if they reach the level of the socket sooner than its base, it is that they are drawn thither even by the tendency of the internal membrane of their sacs which envelope them, and which, from the gummy membrane, connects itself to the neck of the tooth, to which it strongly adheres. That cause is not assuredly unique, it exists at other parts of the gum, which is far from being foreign to that organic action ; in such a manner that at the same time that the tooth is forced to escape from the alveolus, it is effecting, in the interior of the gum, a process by which a way is prepared for its passage.

In the actual state of the science, it is not easy to say if that outlet exists before the eruption of the teeth, or if it is formed at the time of their eruption. Physiologists do not agree upon this point. Some, among whom are Blandin, otherwise inclined, as also M. J. Cloquet, has made a concession to an opposite opinion, viz. "the young tissue being raised, the mucous tissue swells, reddens, inflames and becomes painful ; it very soon becomes white, one or more openings appear upon its surface,

according as the crown is furnished with one or more tubercles, and these last appear outwardly, in the first case, after having *simply dilated* the simple opening which is prepared for it; in the second, after having ruptured the different parts which separate all these special openings, converting them into one.* That opinion, as can be plainly seen, gives us sufficient latitude to explain the diseases generally attributed to dentition.

Other physiologists, on the contrary, at the head of whom is M. Delabarre, contend that the opening through which the tooth passes is not the result of an ulceration of the gum, but of the neck itself, dilated from its follicle, in such a manner that the opening, once effected, need not be enlarged. This opinion, repeated by M. Herissant, who says, *the permanent gums are neither torn nor pierced by the teeth which pass through them, as has been supposed*; this opinion, we say, which leads to the conclusion of an *iter dentis*, has nothing which offends, when we think how great, under all circumstances, is the foresight of nature, as it is also generally admitted; besides, it is another proof to those who believe that the diseases which often attack infancy, during the eruption of teeth, are altogether strangers to it.

Eruption of the Teeth of First Dentition.

The period at which the teeth of first dentition appear is variable. There are examples, as we have before said, of children having one or more teeth at birth; there are other examples, also, in which they have not cut any of their teeth for one, two, three or more years, and still be in perfect health, as Alphonso Leory has stated.† Vanswieten reports a case of a child, very vigorous and healthy, who had not cut a tooth until she was nineteen months old.‡ Charles Raiger has made mention of a child, whose four canine teeth did not appear until the thirteenth year.|| We also find, in Maury's work, a similar case of a young girl, seven years of age, who had not cut the two central inferior

* See the Memoirs of M. Blandin, page 110.

† Traite de Medicine Maternelle.

‡ Comment. in Aphor., tom. 4.

|| Collection Academique, partie étrangér, tom. 1.

incisors. We ourselves have met with several cases of tardy dentition.

We may, however, generally say, that the temporary teeth appear from the sixth to the eighth year after birth, rarely sooner but sometimes later. The order in which they appear through the gums is the same that follow in their development, and are liable to like variations. Thus, from the sixth to the eighth month, the inferior central incisors appear; the superior follow these; one or two months later the lateral incisors follow the same order. At the twelfth or fourteenth month the small molars appear; sometimes, however, the canines appear at this time; finally, the second small molars complete, about the age of two years, or two and a half, first dentition. We again repeat that the eruption of the teeth does not always follow the order which we described, and whoever will observe this process of nature, (a phenomenon as important as it is complicated with the organism,) upon a certain number of infants, will be astonished at the diversity he will meet with. Below we give a table of the usual periods at which the teeth appear.

From 6 to 8 months, the 4 central incisors.			
"	7	" 10	do. " 4 lateral incisors.
"	12	" 15	do. " 4 small anterior molars.
"	15	" 20	do. " 4 canines.
"	20	" 30	do. " 4 small posterior molars.

Total, 20 temporary teeth.

We have adopted, as will be seen, the opinion of M. Serres, who admits, in opposition to the order established by Sabatier, Bichat, Boyer, and the most distinguished anatomists who have preceded him, that the canines do not appear until a few months after the eruption of the small anterior molars. We adopt it as a common consequence of a law of the organization, which we have always been forced to acknowledge, that at all stages the canine are not developed so soon as the first small molar. In justice to the celebrated Scotch dentist, Blake, it is necessary to state that M. Serres has only copied the opinions of this distinguished writer, whose views we have frequently quoted, and who, twenty years previously to the publication of the work of

the latter, said, "On examination of the teeth of a number of children at birth, I discover in both jaws that the crowns of the central incisors are perfect ; that those of the lateral and the anterior molars are far advanced, and that the canines and posterior molars were but slightly developed."

Blake and Serres content themselves by stating this fact ; perhaps, if they had explained it by saying that the office of the canine teeth was to tear, and that it required the assistance of the hands, nature had not seen fit to develop these teeth before the hands were capable of assisting them.

When the crown has entirely passed through the orifice of the alveolus, the gum which is united by its fibrous portion to the external roots, under the name of alveolo-dental periosteum, adheres around the neck of the tooth, which it closely embraces. The maxillary bones at the same time undergo great changes ; their alveoli, which had been distended by the crowns of the teeth which they contained, afterwards contract and adapt themselves accurately to the roots ; this brings about an entire change in the physiognomy of the child.

The milk teeth then continue to increase ; their roots, at first hollow and short, become filled up, elongated, and there is a time during which they are shed and replaced by others. But before speaking of these phenomena, let us examine the organs which, in the jaws, are opposed to them, and which nature has prepared for replacing them.

We have said above, and anatomical researches have sufficiently demonstrated, at the term of gestation we distinctly discover follicles of the incisors, and even of the secondary canine teeth. They are placed in as many alveoli, in the rear (but very deep) of the capsules of the corresponding temporary teeth, from which they are separated by a fibrous partition, the existence of which has been denied by Meckel, on account of its great thinness. But, in proportion as the milk teeth grow, and especially when they have passed through the orifice of the gum, carrying, in its progressive movement, the alveolar processes, it gradually becomes more distant from the follicles which then appear to sink themselves ; the extremity of the capsules, which is immediately connected to the gum, lengthens

out, and forms as many little prolongations, which afterwards being enveloped by the progress of ossification, is found contained each in a little canal.

These are the prolongations already described by Fallopius and Eustachius, and verified by Albinus, Blake and Meckel, to which M. Serres has given the name of *gubernaculum dentis*, wishing thus to express the use to which they were intended. But we will observe, that if they had this office, the teeth of second dentition would always have pierced the place where these canals terminate; but this is far from being the case in the incisors, it is rarely seen in the canines, and never in the molars. Some authors look upon these appendices simply as a kind of elongation of lines of continuity which unite the follicles of the second teeth to the gums; and as to the osseous canals in which they are lodged, as in cases they would be, according to these authors, the necessary result of the ossification of the parts which they traverse. In other respects, these prolongations, an attentive examination of which permits us to prove the existence of the cavity, are in number equal to those of the follicles of the secondary teeth, which alone are provided with them.

When the child has arrived at the age of six or seven years, the permanent teeth are nearly completely developed. The central and also the lateral incisors have already grown slightly near the roots; the crown of the small molars, and those of the canines, are nearly complete. Each jaw contains, at this time, *twenty-six teeth*, ten temporary, ten of replacement, and six permanent, which are the six large molars, the eruption of which, for the four first, generally takes place about the seventh year, and always precedes the loss and replacement of the milk teeth. All these teeth are lodged in a certain number of alveoli, divided in three apartments, the anterior or smaller of these belongs to the teeth of double dentition, and the posterior to the permanent, which are succeeded by no others. The partition marks the limits of these apartments, which separates, on each side, the first large molar from the posterior deciduous molar.

Things are then so arranged that the permanent teeth, that is to say, the large molars, are placed upon a line of the arch occu-

pied by the temporary teeth, which assists in the continuation of the curve posteriorly. As to the teeth of replacement, they present the following arrangement: the incisors and canines are placed in the rear of the roots of the corresponding temporary teeth; the bicuspidetes below the deciduous molars in the inferior, and above them in the superior jaw. By this arrangement, the first and second large molars, which solely occupy all the external apartment, are very slightly lodged here; thus there is reserved for the bicuspidetes a part of the interior of the jaws occupied by the deciduous milk teeth.

The incisors and the canines have been, under the relation of replacement, not as conveniently situated as the molars; they are at first considerably larger than their corresponding temporary teeth; afterwards, they occupy posteriorly a smaller circle in the arch; this causes them to be pressed against each other, so that the alveoli of the four incisors of replacement occupy as much space as do those of the deciduous canine and incisor teeth. It also occurs, from this arrangement, that the canine teeth of replacement, not having sufficient space by the side of the incisors, are deeply imbedded exteriorly in the inferior jaw, and in front of the lateral incisors, whilst the superior incisors occupy, far from the alveolar border, a narrow space which is reserved for them at the base of the apophysis of the superior maxillary.

Finally, when the teeth of replacement have acquired their full size, which happens about the seventh year, it only waits for a suitable time to break the barrier which the gum offers to them, and to rise from the socket. But before this eruption can take place, the milk teeth should give way for them. It is this process which we shall now treat of.

Shedding of the Milk or Temporary Teeth.

We shall now treat of that which generally takes place about the seventh year of age, as the teeth of first dentition are shed, and those of the second commence to appear. The order in which the milk teeth appear is always such as is observed in their shedding. Unhappily, in this circumstance, as in many

others, nature wishes to conceal from us the laws by which she controls her operations. Let us, in the meantime, endeavor to penetrate these views, by explaining, if it is possible, the phenomena which accompany this shedding.

Thus, as we know, each jaw presents, in infancy, two series of parallel alveoli. The anterior series is destined to receive the milk teeth, the posterior encloses those of replacement, so that if the first teeth are not shed before the eruption of the teeth of second dentition, each jaw would be furnished with two rows of teeth: a circumstance very rare, but which, however, has happened.

The first effect of the movement of progression of the second teeth is the pushing or forcibly removing the obstacles which they meet in their course, and which at first consists in the alveolar partitions separating the two classes of teeth. But this obstacle being removed, the roots of the milk teeth experience the pressure; this pressure, gradually increasing, contracts the vessels and nerves of these teeth, and finally cuts off their vitality. The fluids of which the milk teeth are thus deprived, are carried in abundance to the matrices of second dentition, and augment the eruptive force of the teeth of that class.

This method of explaining the shedding of the milk teeth by the mechanical destruction of their alveolar partitions, the compression of their nutrient vessels, and the destruction of their roots, is far from being above all doubt, at first, because it cannot be applied to the very frequent cases in which the teeth are shed without having been in contact with those that are to replace them; in the second place, because they do not show why these teeth, which have ceased to exist before their shedding, are not shed before having lost a part, sometimes even the whole of their roots. It is, then, necessary to add another cause of the change of these teeth to those of which we have spoken, and that cause, which we have believed resided in a particular work of absorption, whose existence we have admitted with M. Delabarre,* who, however, found concerning it some very clear ideas expressed by Sæmmering, and developed by Bichat himself.

* Treatise upon Second Dentition.

Thus, whether the milk teeth, becoming foreign bodies, cause irritation, or whether the development of the permanent teeth contributes to a more active inflammatory action, it is certain that the vitality of these parts and consequently the energy of their absorbent functions, are always considerably increased. This results from the destruction or rather absorption of the phosphate and carbonate of lime which enter into the composition of the roots of the milk teeth. This kind of wasting away ordinarily commences at the extremity of the roots, which become unequal, rough, and gradually disappear; it is not effected, as some other organs subject to like destruction, at the expense of all the exterior or deep molecules of which they are composed; all this commences at the surface, and proceeds from the circumference to the centre; but the enamel always resists, except towards the internal part of the crown, where it has been observed to be sometimes eroded.

This mechanism is the same for all milk teeth; but the destruction of the alveolar ridges takes place differently around different teeth. Around the incisors and canines the ridge is destroyed perpendicularly, but around the molars the process is more difficult, for the reason that their roots diverge to the right and left in the jaw, more especially in the superior. This work of destruction commences here on a level with the alveolar border, from thence it goes on; the ridge of porous tissue between the roots is the last destroyed, upon the phenomena of which we shall soon treat.

Such is the mechanism of the shedding of the temporary teeth; the explanation which we have given of it is simple, and in conformity to the laws of our organization. This loss of the temporary precedes the eruption of the permanent teeth, of which we shall presently treat. These two phenomena are so connected, the one with the other, that children who lose their first teeth prematurely, are those whose second teeth are the most precocious.

Eruption of the Teeth of Second Dentition.

We shall now see how the shedding of the teeth of first dentition is effected, and treat of their immediate replacement by

other organs. This process is subject to great variations ; for, indeed, we often find that the destruction of the roots of the milk teeth progresses so slowly that these organs maintain their positions and impede the progress of the temporary teeth ; on the other hand, from some unknown cause, the replacement of the teeth does not occur until a very long time after the moulting of the milk teeth.

We find, in the *General Archives of Medicine*,* the example of a woman, aged forty-three years, who had her four incisor teeth posterior to the four deciduous incisors. A year later, the four molars, which until this period were wanting, showed themselves. Her parents said that she yet had milk teeth. We know of several similar cases.

After the seventh year, at which period there are twenty teeth situated in the whole extent of the alveolar arches, between the maxillary tuberosities above, and the coronoid apophyses below, these arches ought to receive successively the second teeth which replace an equal number of temporary, and posterior to these are added three new organs in each side of both jaws. But how do the maxillary bones adapt themselves to the arrangement of all these productions ? How do the teeth arrange themselves in a line upon the alveolar borders, without impeding each other in their course, without turning each other from their route, without usurping the place of each other ? Let us endeavor to unravel this intricate question, whose solution is far from being unimportant.

At first the development of the maxillary bones does not go on simultaneously and in a continued manner upon every part of their extent, as we observe in the other parts of the osseous system. The cause of this difference is that these bones present in their composition two substances essentially distinct, as much by the manner in which each one develops itself, as by the ulterior metamorphosis that they undergo. Concerning these two substances, the one belonging to the general osseous system, forms and regulates itself according to the laws which regulate the other bones ; it comprises nearly the whole of the

* June number, 1840.

jaws, or rather it forms, truly and properly speaking, the maxillary bones ; the other constitutes the border or alveolar process. Although this last may be equally osseous and lasting as the first, it forms not an essential part of it, and is, as it has been plainly said, only a phenomenon of dentition ; it appears in the same time with the organs which produce the teeth, it is developed with these last, moulds itself upon their external forms, follows their direction, undergoes all the changes to which they are subject, and disappears with them.

If we examine the interior of the jaws soon after conception, [six or seven weeks,] we will be convinced of the truth of what we are about to relate. In fact, the interior of the jaws is, at this period, filled with a spongy tissue, whose pulps contain the rudiments of dental follicles. These follicles soon give birth to [the rudiments of] teeth ; these necessarily expand, and by the great volume that they acquire, the cellules of spongy tissue, in the midst of which they are plunged, press on all sides against the neighboring cellules, and cause the ridges that separate them to disappear, transforming them into thin layers of compact substance, whose reunion constitutes the solid walls of as many cavities or distinct alveoli as there are crowns of new teeth. And when these, continuing to increase in height, have pierced the gums, the roots which follow them, being much smaller, the remaining space is filled by the closing up of the alveoli.

During the eruption of the milk teeth, the alveolar arch assumes the best arrangement for the accommodation of these organs, the jaws, as we have already seen, taking the most ample dimensions, sensibly elongate, their angles become more distinct, the substance of the bones themselves deepen, while the alveolar borders diminish in thickness after the completion of dentition.

The temporary teeth having all appeared, is the maxillary arch always of the same size ? Blake and many other anatomists, among whom are Sæmmering, Sabatier, Boyer, Bichat and Beclard, his worthy commentator, finally, of a later day, M. Serres, have thought these arches elongate during the whole period between first and second dentition. Hunter contends, on the contrary, that from the age of fifteen or eighteen

months, the anterior part of the jaws do not grow, and his opinion is maintained by Fox* and M. Duval. M. Oudet, holding this opinion, to the triumph of which M. Miel† has written a memoir, dedicated to the Medical Society of Emulation, has taken from twenty children, selected promiscuously, at the age of three years, plaster models of their teeth; and after having repeated upon them, *even to the age of six years and a half*, the same experiments, at intervals more or less near to each other, he pretends to have always found, during this period, the arch to be uniformly of the same size, and that the relation between it and the teeth to have undergone no change.

These two extreme and opposite opinions are, according to our belief, both equally destitute of foundation. In fact, in admitting the progressive increase and continued growth of the alveolar arch, Blake has confounded the maxillary bones with those of their border, in which the teeth are implanted; for if the growth of this last was continued uniformly, as those of other bones, it would exactly follow the laws which govern ossification generally, and from whence follows two conclusions: first, that the temporary teeth, from the moment they appear are always inclined to separate, and leave a space between them; second, that the alveoli, in dilating, abandon, without support, the teeth they contain. Now, observation proves, although Beclard and M. Serres assert the contrary, these two facts never existed. Then the alveolar arch does not sensibly increase between the two dentitions.

It is this immobility in the alveolar processes, in opposition to the progressive growth of the jaws, that makes, at six years, the mental and suborbital foramina still more distant from the first temporary molar. This immobility, however, applies only to that portion of the arch which receives the temporary teeth, for, posteriorly, they are elongated for the reception of the second adult molars.

But then, if the opinion of Blake is false, is not that of Hunter, strongly defended by M. Duval, Miel, etc., necessarily conforma-

* Natural History and Diseases of the Teeth, translated by Lamaire.

† Some Ideas upon the Two Dentitions.

ble to truth? No; for the reason, that if the alveolar arch did not grow between the two dentitions, it is conclusive, against the most absolute evidence, that this arch is of the same size in the infant that it is in the adult. This growth commences at the moment of the eruption of each tooth of replacement; it is a necessary consequence of the intimate dependence in which the teeth hold the alveoli, which belong to them much more than to the jaws, and yield to their effort as an elastic barrier, which permits itself to be extended. Thus it is, that each tooth augments this arch only in the degree necessary for its own accommodation. Nevertheless, let us remark, that this growth is less than one would naturally suppose; for observation demonstrates that if the incisors and canines of replacement are larger than those of the deciduous set, the temporary molars are larger than the bicuspidæ which succeed them, so that what the jaws lose in space anteriorly, they gain posteriorly. But the same changes do not take place in the two jaws; in the superior, the relation between the gain and loss of space is less as the growth of the arch which confines this species of fixture, which the superior maxillary receives with the bones with which it articulates.

And are irregularities of dentition more common in the superior than inferior jaw?

In order to reduce this question to all possible precision, and to avoid details that would be more appropriate to a special memoir than to an elementary treatise, we may say, the ten teeth of replacement of the inferior jaw require, in order to arrange themselves, a space necessary to twenty; they only find a space equal to seventeen; of the three-twentieths wanting, they gain two of them by the increase they themselves occasion in the alveolar arch, and one by the small space that the two small deciduous molars allow to the two teeth of smaller size which replace them. In the superior jaw on the other hand, the three-twentieths that are wanting after the fall of the first milk teeth, are obtained, one by the increase of the alveolar arch, the second as in the inferior jaw, by the difference in volume between the two classes of teeth; and finally, the third by the direction of the incisors, which make room for them by diverging a little. It is from this slight divergency, so perfect in the adult, that we

think the encasing of the two anterior tiers of the inferior jaw by the superior is occasioned.

We repeat, if the eruption of all the second teeth were to take place at the same time, their arrangement, doubtless, would be irregular, since, in the superior jaw particularly, as we have seen, they would find an insufficient space. But this is not the case, the fall and replacement of the teeth do not happen at the same time. These organs have to pass through a series of consecutive phenomena, which embraces an interval between the sixth and seventh years; thus each, proceeding separately, has time to advance regularly, and to assume its proper position. If the anterior arch of the jaws increases gradually, in proportion to each new tooth, all would place themselves in the semicircular line that they should occupy; but if this arch experiences ever so small a variation, it is generally the canines that cause the irregularity, because, commonly appearing behind, they are then obliged to deviate themselves, or cause other teeth to do so, in order to pass through the gums. This places beyond doubt the possibility that the teeth possess the ability of causing the alveolar arch to yield; this happens in cases of supernumerary teeth, examples of which Camper and Sæmmering have given; we have also seen them. This arch in front allows all necessary space for the accommodation of supernumerary teeth.

Let us examine the intermediate points through which nature passes to accomplish her desired end, which is to furnish the jaws of the child with teeth that are most capable of performing the necessary functions at that period.

The renewing of the teeth according to the progress of their eruption, commences always with the incisors. The central inferior incisor appears first; a short time before the shedding of the temporary tooth, it gradually elevates itself in the interior of the alveolus of this latter organ; it pushes it from below up, so that the temporary tooth is merely retained at the orifice of the alveolar cavity. It is at this period that the tooth of replacement effects a slight enlargement of that small portion of the dental arch to which it corresponds; the enlargement is visible a short time before the shedding of the milk tooth, which is sensibly removed from its neighbors.

When, by some cause, the milk tooth is shed at a proper time, we observe the permanent tooth coming through behind the dental arch in an oblique position, which causes it to appear in front of one of its lateral borders; we at first believe, from its enormous size, that it is too large to be received into the place to which it is destined; it, however, gradually redresses itself during its progress upwards, assumes a direct position, elongates and enters into the space that it should occupy; it then presents no irregularity of position. What we have just said is applicable to all the incisors, which are subject to like phenomena upon the dental arch that they occupy.

All the permanent incisors are well arranged during the course of the ninth year. There the work of replacement stops some time, and it is only towards the end of the tenth year that we perceive the first small molar or anterior bicuspid, in whose arrangement we do not perceive the least difficulty, since it has a volume much less than the molar milk tooth that it ought to replace. Soon after, the second small molar appears; then, at about the eleventh year, the canine, which does not at first occupy its position upon the line of the arch, but delays to do so some time.

Very nearly at the same time that the two canines are cut, we perceive the second large molar; finally, the last, which is the wisdom tooth, appears from eighteen to twenty-five years. The time of the cutting of this last is variable. Hippocrates has fixed its appearance between the thirteenth and fourteenth septenary. It is principally among women that this tooth remains sometimes forever enclosed in the interior of the jaw; the result of this generally is a less spacious maxillary bone, without that their teeth would have less volume. Of all, the wisdom teeth are most subject to anomalies of form, volume and position. The following table presents the ordinary phases of second dentition:

From 6 to 7 years,	the 4 first large molars;
“ 7 “ 8 “	“ 2 inferior central incisors;
“ 7 “ 9 “	“ 2 superior central incisors;
“ 8 “ 10 “	“ 4 lateral incisors;
“ 9 “ 11 “	“ 4 first small molars;
“ 10 “ 12 “	“ 4 canines;

From 11 to 13 years, the 4 last small molars ;
 " 12 " 14 " " 4 second large molars ;
 " 18 " 25 " " 4 third large molars, or wisdom teeth.

Total, 32 permanent teeth.

During the replacement of the teeth, some changes that we should mention are taking place in the jaws. Their bodies become more extended in height, the suborbital holes and mental foramen elongate from the alveolar process and from the symphysis, and correspond, at about twenty years, to the root of the second small molar. The crookedness that the base of the inferior jaw presents, at a young age, disappears gradually, and becomes angular. The superior alveolar floor contracts transversely at the seventh year, finally enlarges itself very sensibly in this respect, in proportion as the growth of the horizontal portion of the maxillary bones progresses. The inferior arch does not dilate sensibly, as we have said, and preserves, crosswise, nearly the same separation before and after the renewing of the teeth.

But the most important modifications are those which take place in that portion of the maxillary bones which corresponds to the posterior extremity of the arches. That portion of the dental arch contains, principally, only the first large molars, is considerably enlarged, in order to receive the wisdom tooth, which ranges itself behind them ; it is that elongation of the arches posteriorly which develops the face, and consequently distinguishes the adult from the infant. In the inferior jaw, it causes the gradual redressment of its branches, in such a manner as to make them describe, with the remainder of the bone, an angle less and less obtuse, whilst to the upper jaw it causes posteriorly pterygoid apophyses ; that the maxillo-palatine suture, which, in the young child, was situated opposite the space contained between the posterior temporary and first permanent molars, corresponds at a later period to the second, and finally, when the work of dentition is completed, it finds itself a little posterior to the wisdom tooth. The elongation of the posterior part of the superior arch coincides with the growth of the maxillary sinus, a double effect which has for its object the development of the large molars, to the volume of which it is always proportioned.

Phenomena subsequent to the Arrangement of the Teeth.

When the teeth have cut the gums, their crowns have acquired their full size; but this is not the same case with their roots, which still continue to increase in bulk and length. As the roots grow in length, their canals diminish in size, and the cavity in their crown gradually disappears. The crowns of the teeth, submitted to the action of foreign agents, become affected by them; the denticulated edges of the incisors gradually wear away, the summit of the canines becomes at first smooth, and then obliterated, and the tubercles of the molars diminish in size, and finally disappear.

While these changes are going on, the pulp forms new layers of bone, and the cavity which it occupies gradually diminishes; these vascular and nervous communications, and sometimes even the production of its secretion, becomes altered. When the teeth arrive at that stage that the blood no longer penetrates their cavities, and that their nerves no longer communicate their influence to them, they change in color, become truly foreign bodies, loosen, and rise from their gums, and finally drop out.

The alveolar processes do not undergo remarkable changes as long as they are occupied by the teeth; but so soon as these organs are lost by disease or accident, the vacuum that their loss occasions diminishes, fills up, and after a few years disappears. When once the jaws are deprived of their organs, their bodies diminish very much in size; from this loss of their alveolar border, they assume the circular form that is had during infancy; the suborbital and submental foramina are then near the edge of the jaws; the maxillary sinus and tuberosity return upon themselves: the branches of the inferior jaw are thrown back, and assume almost the same direction which they had during childhood. Finally, deep wrinkles, prematurely marking the face, show a loss in the vertical diameter of the face, which constituted its principal and most handsome feature.

All of this process occurs according to design of nature, which has caused that the two dentitions, of the divers phases of which we have spoken, should suffice, in each individual, through life. There are, however, well authenticated cases of

nature having deviated from her usual course, and that a third, and even a fourth dentition have occurred.

These new teeth, a freak of nature, as if to show the effort and resources of the economy, may appear at any period of life after the time destined for the eruption of the last molar teeth. Their eruption has been viewed by physiologists and authors who write upon dentition, only as a curiosity or an unusual occurrence; but they merit a more serious recognition, since they may produce injurious effects to the regular dentition, under the impression that these new organs have to pass through the gum nearly of a cartilaginous consistency.

Sennertus* relates a case of a lady who, during her sixty and some odd years of age, cut twenty new teeth, the eruption of which occasioned diseases analogous to those which children experience during first or second dentition. Joubert speaks of of a similar case, of a woman seventy years old; and a German author, Ungebauer,† states, that twelve teeth of a child of ten years of age, were three times shed.

If examples of the almost complete renewing of the teeth present themselves so seldom that some authors have thought proper to deny them, this cannot be urged against the partial renewal of some. This last phenomenon often occurs, and has been noticed by men of undoubted veracity, or at such recent periods that it cannot be doubted. Eustachius, whose anatomical works exhibit so much sagacity and precision, has seen the incisors of a youth, twenty years of age, after having been drawn, to be replaced by others during the same year. Dufay, physician for the port of Lorient, has, in that town, seen a man fifty-four years of age, to whom nature, at that age, had endowed with two incisors and two canines. Gehler, who has written a work upon third dentition, relates a case of a canine tooth, which had been three times extracted, and had been three times replaced by a similar organ. Haller states that he has seen this phenomenon, which Cardan and Diemerbroeck had witnessed in themselves, the former at fifty-three, and the latter at fifty-six years of age.

* *Dissertatio de Dentium Dolore.*

† *De Dentitione Secunda Juniorum.*

The most remarkable examples of this nature have been reported by M. Serres, who witnessed them in the charity hospital. One was a man, aged thirty-five ; his two inferior central incisors dropped out accidentally, and were replaced, within a few months, by two others. The other case was an individual, seventy-six years of age, who, when recovering from an attack of bilious fever, experienced, in the inferior jaw, lancinating pains, accompanied with tumefaction of the gum and cheek, which terminated in a multicuspid, situated upon the surface of the part that the second large molar of the left side had occupied. The alveolar border of this old man had not been absorbed, the symphysis of the chin did not project forward, and the angle of the jaw recede, as it should have done ; hence M. Serres inferred that there were other germs of teeth enclosed in the jaws, and that new teeth would, after a time, show themselves.

The foregoing case of M. Serres may give rise to the following question : are there in the jaws several germs, or do the germs contain organs capable of forming and producing new teeth ? The first of these questions appears to us to be the most plausible one ; for it is more simple, as the learned author whom we have just quoted says, to admit that certain individuals may be born with supernumerary germs of teeth, as we see them come into the world with supernumerary fingers, kidneys and ovaries, than to attribute to the teeth the faculty of reproduction. We have in our possession several pieces of pathological anatomy, which would lead us to that conclusion, and which the recent observations of Lemaire and Blandin would confirm. The first of these gentlemen extracted a canine, from which he readily detached four distinct teeth ; the second found, in an adult jaw, a new tooth, the crown of which was partly formed. It is certainly from such germs that we should attribute the dentition of old persons.

Functional Importance or Uses of the Dental Apparatus.

The part that the dental apparatus takes in the execution of the inherent functions of the human organism, is as varied as it is important ; but of all the attributes which are attributed to it,

the most prominent, those to which it is most adapted, from the nature of its formation, are prehension and mastication. We will examine these two functions, which, reduced to the physical properties, according as they are accomplished, resume them in action: the first, as a pair of pincers to tear and cut; the second, as a vice to bruise, and as a mill to grind.

Prehension and Mastication.—All of the teeth may be employed, says M. Blandin, in the prehension of solid substances; but the incisors are better adapted to this office. Pressing in a direction opposite to the materials to be divided, they are well arranged to accomplish this function, for they have cutting edges, and cross so as to act like the blades of scissors; but, on the other hand, placed at the extremities of the jaws, which there form a lever of the third species, the masseter muscles of which are the power, the tempero-maxillary articulation, the point of support, and the body to be divided, the resistance; they are so arranged as to exercise great force, especially upon large bodies, which, requiring the jaws to be opened wide, and put the elevator muscles of the inferior jaws in the position to act very obliquely upon the arm of the lever of resistance. Hence, as all physiologists have remarked, when we wish to break a hard substance, we instinctively place it far back in the mouth; and by shortening the arm of the lever very much, by which the resistance acts, we correct the lever of the third species, which, although employed oftener in animal mechanism, is, moreover, the most useful of all.

The canine teeth, on the other hand, from their pointed shape and great power, are more adapted to tear than to cut. These two offices occasion the teeth to be employed both in the prehension of the food on the one part, and the extensor muscles of the head on the other. They then act like pincers, with which we would hold the body that we wish to tear; the point of support which they afford in such case is sure, by the length of their roots, in proportion as they firmly set in the jaws.

As to the molars, their form and position in the posterior part of the mouth, render them altogether unsuitable for prehension, except in preliminary circumstances, when the assistance of the teeth is required for bruising a body, or for holding it, while it

is being torn ; they afford, in this latter case, much better the power of retaining objects, as they are placed near the muscles charged with the office of closing the jaws. But this is not so in mastication ; they combine the most proper conditions in that process, which has for its object the faculty of bruising and reducing food into very fine particles. By the great volume of the crowns, furnished with asperities, which alternate from one jaw to the other, they can retain for a long time substances upon their surface, as if placed between two mills, the office of which is to triturate them.

We should notice that it is not solely in the arrangement of the teeth that nature has taken such happy precautions for the execution of the process which now engrosses our attention ; she has likewise established the most perfect concord between the functions exercised by the superior and inferior jaws, and in such a manner that the former acts like a hammer upon an anvil. The superior incisors also, which never have to undergo forcible offices, are situated below the nasal cavities ; while the canines find, in the external orbital apophysis of the frontal bone, a support which enables them to resist the force which is often required of them, and which, posteriorly, they are compelled to remain strictly tight during mastication, which almost entirely devolves upon them ; “nature has doubly protected the superior alveolar border against the base of the cranium, by placing between them the *zygomato-jugale* and pterygoiden columns.”

It is not merely the conical form of the roots which concur mainly to the transmission of forces, by causing the efforts that they have to sustain to be lost upon the alveolar borders, which closely embrace them. The number of the roots, are they not also in proportion to the violence that each class of teeth have to sustain ?

Because each tooth generally has distinct functions, we should conclude, however, that their action is separate, and that the labor of some ceases when that of others commences. When food is once reduced to a proper size, by the teeth, it is successively carried from one tooth to another, by the combined motions of the tongue, the lips, and the cheeks, and committed, by turns, to a vertical pressure and a horizontal grinding.

This process is well performed, when the teeth of both jaws are arranged in the following manner: the superior central incisors close before the inferior central and half of the lateral incisors; the superior lateral incisors correspond to the remaining half of the inferior lateral and half of the canine teeth; the superior canines pass before the remaining half of the inferiors and half of the first small molars; the first small molars of the superior jaw cover the first and second inferior molars; the second large superior molars cover the second and third inferiors; finally, the superior dentes sapientiæ correspond to the inferiors which pass them, to a greater or less extent.

The great precaution, as can be readily seen, which nature has taken to render the action of the teeth upon alimentary substances, are numerous and wonderfully combined, and nevertheless they cannot appear to be exaggerated, except to those persons who are so blind as to forget the influence of mastication upon digestion. "When great numbers of the teeth are missing, so that mastication cannot be continued for a sufficiently long time, chymification is with difficulty performed; the stomach, irritated by refractory aliment, because it is not sufficiently masticated, becomes inflamed, and other injurious consequences arise from it. Old men, who have lost their teeth, are obliged to adopt a suitable regimen, under the pain of suffering injurious consequences;" if they would not prefer to have recourse to dental prothesis, which offers to them the sure means of preventing these injurious results, as daily experience testifies, and which we shall very soon attempt to prove.

Articulation of Sounds.

If there is a fact that it suffices to express, in order that it may be immediately understood by every one, it is the influence of the teeth upon the pure and clear articulation of sounds; for if the voice is the product of the vibrations that the air exhaling experiences in crossing the larynx, the word, as Magendie* justly says, results from the modification of the voice by means of the

* Elementary Treatise on Physiology.

tongue, whose most movable portion strikes at one time the palate, at another the teeth. But all the teeth are not equally important as it regards this: the incisors should be placed first; we readily see their want of thickness and the width of their faces make them true sonorous bodies, as well as their position at the confluence of the column of air which escapes from the mouth; the canines come next; then the small molars; the last have little or scarcely any influence upon the pronunciation.

The better to appreciate the importance of the teeth in articulating sounds, it is only necessary to observe those who are deprived of them altogether or in part. Let us notice, in regard to this, some details, whose recollection will serve at least in the completion and combination of the different pieces of dental prothesis.

The loss of teeth is partial or complete, and each of these circumstances has, in a word, inconveniences which belong to them, and which vary according as the loss affects the superior or inferior jaw. For example, persons who have lost the central superior incisors, cannot pronounce agreeably dental syllables, which take the labial accent, and their conversation is often but a continued hissing. If, on the contrary, these same teeth are wanting in the inferior jaw, the guttural consonants, such as G, take a sound which is midway between that which belongs to it and that of Gh and Ch, and which often prevents them from being understood.

When the inferior jaw has lost all of its teeth, the sound of the voice is not changed, the pronunciation only is altered; but it is not so with the superior; as soon as it is deprived of its teeth, the alveolar border sinks, and, the palate having lost the concavity that it acquires by the development of the permanent teeth, the sound of the voice becomes harsh and guttural; for it is a fact worthy of observation, in every point conforming to that which establishes theory, that the more the palatine vault becomes flattened, the less brilliant and forcible the voice, even among persons furnished with all their teeth; that which confirms this opinion is, *that the palate is a vocal pipe like that which is the parillier to the instrument called horn.*

Then, the loss of the teeth has as much more influence upon

the diminution of volume and force of the voice, as it is more complete, and as the alveolar border is more depressed. When they have totally disappeared in both jaws, the voice loses not only its force, but its harmony; it becomes, as Delabarre remarks, sharp and suppressed, the pronunciation can be accomplished but very imperfectly, and only by a new mechanism, which demands, in every case, a long exercise, often even a painful habit.

Secondary Functional Importance.

The assistance the teeth offer to man is first, in his life, by nutrition, by the work of preliminary disintegrating that which is necessary for nourishment; secondly, in his life by relation, by the active part that they take in the articulation of the voice, constituting, as we have said, their principal functions, but these are not the limits of their physiological acts. Being placed at the superior extremity of the digestive tube, they assist in forming a barrier which retains in the interior of the mouth the saliva destined to facilitate the actions of the different movable parts of that cavity, and to augment the digestibility of the alimentary bolus; approaching the superior members, they are able to be of assistance to the hands, as a support, to conquer resistances, and to become even in some cases a means of defence and attack.

Finally, if they exert an action upon the organs, they are also in their turn influenced by them. Although it seems effectively paradoxical at first to sustain, by example, that the lips, the cheeks and the tongue assist, not in giving to the teeth the proper direction, but in maintaining them in this direction, still nothing is truer. When the lips are destroyed, the teeth direct themselves without, whilst they incline inwardly when the tongue is cut off or diminished in volume. We have had recently occasion of proving this last result, upon a subject who had long since lost the anterior part of his tongue. We can then assert certainly, with Blandin, that the teeth are naturally placed between two forces, which affect them in opposite directions, the one from without to within, the other from within to without, and that from this equilibrium results a great part of the sensible vertical direction that they have amongst us.

If, in order to complete the examination of the list that acts in the economy of organs which we are now treating of, we wish to study the character that they imprint upon the physiognomy, we should only notice the influence of their loss in this respect. Now, that influence varies according as the loss is total or partial, and according as they have a place in the upper or lower jaw.

For example, the loss of eight or still more of the ten anterior teeth of the inferior jaw only thickens the lower lip, and renders the chin pointed, by the retreat upon itself of the alveolar border, which contains the teeth. If to this loss we add a parallel one in the superior jaw, the middle part of the face becomes square, and the physiognomy wears a sad and monotonous aspect. If it has only a place in the superior jaw, the change is still more apparent; for the upper lip, wanting support, sinks in and leaves the lower one projecting out; at the same time the nose seems to be forced in. The molar teeth only, on the contrary, being wanting, the jaws flatten, become flabby and hanging, and the form seems elongated. As to the loss of the teeth of both jaws, the result inevitably is to diminish the vertical diameter of the head, and consequently to shorten its form.

SUMMARY AND CONSEQUENCES OF THE PRECEDING PHYSIOLOGICAL FACTS.

As we have been obliged, in the description of the physiological phenomena which belong to the dental apparel, we have given some discussions and even sometimes made some repetitions, which might be able to cast some uncertainty upon the mind in regard to the principal points of these phenomena, we shall briefly recapitulate.

Now, we have seen that all the teeth, as well of the first as of second dentition, exist in the jaws of the fœtus; their development takes place in the following order:

1st. After the third month of intra-uterine life, the germs of the milk teeth are apparent, under the form of a small stony pulp or papilla, which seems to be but a mixture of vessels and dental nerves, enclosing, in a sac, a kind of capsule called follicle.

This folliculous membrane, which we believe to be of a serous nature, is composed of two leaves, an external one, which is confounded with the alveolo-dental periosteum, and an internal one, whose exterior surface is moistened with a sero-mucous fluid.

These follicles, appended to the gummy membrane, as a fruit to a horizontal branch, are not developed at the same time, nor do they offer the same disposition. Towards the middle of the third month, we distinguish, upon each half of the two jaws, four sacs, two before, two behind, inclining by pairs, which leave between them an interval. The first, smaller, belong to the temporary incisors; the second to the molars. A fifth sac, at a later period, fills the interval, for the canine, which forms the total number of the follicles of the first teeth.

The follicles or germs of the teeth of the second dentition, according to Serres, appear after the end of the fourth month; those which belong to the two large first molars first, and upon the same line as the germs of the milk teeth; afterwards, but only towards the end of the seventh month, do we see the follicles of the secondary incisors placed precisely behind those of the primitive teeth to which they correspond.

2d. A little after the appearance of the follicle, the tooth commences to develope itself interiorly; the top of the crown appears first. The formation of bone is announced by a reddish circle around the more prominent parts of the papilla. Afterwards, the production of the calcareous bony matter, which is effected by a true secretion, deposited under the form of very fine scales, encasing the tubercles of the papilla, of which they are equal in number.

We admit, generally, that of the two substances, the ivory and enamel, which form the hard portion of the tooth, the ivory is secreted first. It forms itself upon the surface of the papilla in circular lines representing horn, which is enclosed from without inwardly, as rolled wafers, and has for the time of its formation only the development of its roots. The enamel, on the contrary, is secreted by the external face of the interior leaf of the membrane of the follicle, and seems to be deposited in crystals upon the crown; but no person, to our knowledge, has

explained in an unclouded manner why the crown is the only part of the tooth which is covered with enamel.

3d. When the first bony cap is formed around the papilla and envelopes it on all sides, new layers form themselves in the interior, and are embraced in the last in the whole of its circumference, even to its base. Then the crown is formed ; but soon new layers of ivory envelope inferiorly this papilla, surrounding its pedicle, descending even to its extremity, and forming the root. Finally, when the papilla becomes closely covered in all parts, it cannot extend its functions of secretion, the growth of the tooth is entirely accomplished, and can never go beyond, as we remark among rongeurs, who have the central canal of their incisors extremely extended at its entrance.

It is only towards the end of the last month of gestation that the solidification of permanent teeth commences, which commences by a speck, which we perceive upon the first large molar. In the eight first months after birth, the central and lateral incisors and canines solidify successively. The formation of small molars rarely takes place before the fourth year ; afterwards the second large molars ; but the wisdom teeth do not ossify ordinarily until the eighth, ninth and tenth year.

4th. The milk teeth, to the number of twenty, appear ordinarily from the sixth to the twenty-eighth month after birth, rarely sooner, but sometimes later ; their cutting depends upon the time of their development and solidification ; ordinarily, the inferior median incisors appear first. All are generally cut at the thirtieth month. Their escape from the alveoli, which cannot contain them, is owing to the progress of their growth, and to *nothing else* ; and if they gain their opening sooner than their base, it is because they are drawn there by the same disposition of the internal leaf of the capsule, which separates the neck of the tooth from the gum, to which it strongly adheres.

As to the shedding of the milk teeth, it takes place simultaneously with the cutting of the teeth of replacement. This double phenomena ordinarily commences at the seventh year, always with the inferior central incisors, and terminates ordinarily towards the twelfth year, with the second small molars ; but it is preceded for some months only by the first large molars,

which are permanent, and immediately followed by the second large molars, which appear five, ten, and sometimes fifteen years before the wisdom teeth.

As soon as the teeth have come through the gums, they have acquired the volume they will have during the whole of their duration. During the interval which separates the cutting from the shedding of the milk teeth, the bodies of the maxillary bone increase necessarily, as all the other parts of the skeleton, but the alveolar arch, properly said, experiences no change in length; as the teeth remain always in juxta-position, that which might not have room in the case or space enlarges itself; they might leave between them some space. But, at the cutting of each tooth of replacement, the arch dilates with it, experiences a growth proportioned to the volume of the new tooth, which it is ready to receive, and which is undoubtedly larger than those of the milk teeth.

5th. The duration of the teeth is very variable, and depends upon the use made of them, the care that they have had, and the diseases to which they have been subject. In the meantime we can say that in general they carry, from an early period, the marks of wearing away, which blunts at first the cutting edges of the incisors, and at a later period wears off the tubercles which form the summit of the crown of the molars. At their shedding, the alveoli that were empty diminish, sink down, and after some years disappear entirely. The jaws once unfurnished, their bodies diminish in volume, and return again to the circular form that they had at a young age; at the same time the face loses a part of its vertical diameter.

Such is the summing up of the different phases through which the teeth pass successively, from the moment of their formation to their shedding, which happens, unfortunately, nearly always before their assistance had ceased to be useful to us; such are the principal physiological facts which should serve as a guide in the methodical study of their diseases. But what consequence shall we deduce in order to establish the proper degree of vitality which belongs to them? Is it necessary, in a word, to place them in the range with organic living tissues, or regulate them in the class of inorganic productions?

Let us examine this question without prejudice, and perhaps we can resolve it simply, in separating from each of the two prevailing opinions all that which is exaggerated, and substitute a less term in the consequences to which each of them has been conducted, as rules in pathology and therapeutics; rules which do not surely accord always with physiological facts which serve as a basis.

It is natural that the teeth, placed at the entrance of the digestive canal, destined to the laborious functions of crushing the food, exposed to the attacks of foreign bodies, to the contact of the air, and to the sometimes rough and violent movements that the two jaws exercise upon them, should be the most hard and compact of all bodies that enter into our organization. At no very distant period, in which they were counted amongst the pieces of the skeleton, they were considered to possess a vitality equal to the bones. But from the time that it was discovered that those of their parts upon which devolved their functions, their crowns were covered with a calcareous matter of a stony hardness, which, in its formation, passed through none of the intermediate points through which the osseous tissue did, and in which could be discovered neither pores nor cellules, this opinion was believed to need some modification, and there arose from it this opinion, that negative characters belong to the tooth entirely, which belonged only to the superficial envelope of its crown; that is to say, the teeth were regarded as inorganic bodies.

It is in vain that the advocates of the doctrine of the vitality of the teeth, at the head of whom are placed Mascagni, Blake, Fox, and whose number is augmented by Duval, Delabarre and Toirec, allege, as a demonstration of the fact, the presence of vessels and nerves in their bony parts:

1st. That the teeth bleed, that their wounds are painful when penetrated to a certain depth, and that the acids cause a particular sensibility in them, as also certain caries and some superficial wounds.

2d. That they become discolored when an animal is nourished upon madder, and that in certain diseases they take a tint, red in the cholera and some cases of asphyxia, yellow in the jaun-

dice, blackish in adynamic fevers, whitish in diseases attributed to lymph.

3d. That their fractures or solutions of continuity perfectly cicatrise, and that they will become impaired as promptly as artificial teeth, if they contain not the elements of organization.

The advocates of the contrary opinion, supported in their researches by Eustachius, Duveney and Hunter, to whom the illustrious Cuvier has lent the aid of his name, have replied :

1st. That if deep wounds furnish blood and cause sharp pain, these result from the papilla being affected ; that the phenomenon of teeth set on edge can be explained by the imbibation of the ossiform part or of the calcareous layers, and by the direct action of an acid upon the papilla, and that the wounds and superficial caries develope only the pain, by producing the destruction of the tooth, and by rendering their external envelope less fitted to preserve the papilla against exterior agents.

2d. That the coloring of the teeth by madder deposes much more against than for the vascularity of the teeth ; for if the experience of Hunter establishes that, in these cases, the coloring matter is deposited in the parts of the teeth which form during the time that experience contends, they have proved, also, that the parts first developed preserve their primitive color ; that which happens to the true bone, which, under the influence of madder, colors it in every instance red ; as to the color that they take in certain diseases, they owe it to a simple imbibation, whose materials are conveyed into the dental cavity by the nourishing vessels of the papilla.

3d. "That if fractures *cicatrise*, it is always *the result of a new ossiform production, secreted within by the papilla* ; and if the natural tissue of the teeth is not impaired as artificial animal teeth, it is by an analogous reason to that which causes the nails not to dry so much as to remain adherent to their matrix, because they are surrounded by parts which keep them moistened with a substance which they imbibe, and which maintains them in their normal state."

As we see, if some of the objections made to the vitality of the teeth seem established, others also seem more specious than solid ; for example, in taking in the following order, in which

they were stated, we are forced to avow that the phenomena of teeth set on edge is sometimes too quick, and depends in some instances upon causes too light to be explained by the imbibation of the ossiform part or of the two calcareous layers of the teeth, which, at an advanced time of life, form nearly all the thickness of the crown.

To maintain, in the second place, that the coloring of teeth in certain diseases, is owing to imbibation, is to avow that their ossiform tissue is so permeable that it permits itself to be penetrated by every colored liquid with which they come in contact, that which is not positively certain, and which does not explain how they take their normal color at the recovery from the disease ; or it is to admit that the vessels of the papilla continue in the ossiform part. As to the inductions which are believed to be drawn from the manner in which, according to Hunter, the teeth are colored under the influence of madder taken as nourishment, we have already said that Flourens has proven that they rest upon facts badly observed.

Finally, to explain the cicatrization of fractures of teeth by the secretion of a new ossiform substance, is, on the one hand, to forget that we have recognised in principle that the secretory functions of the papilla cease entirely when, by the complete formation of ivory, it is reduced to a nervo-vascular cord which forms its centre ; and it is, on the other hand, to assimilate the teeth to bones, whose fractures consolidate as by a new calcareous cellular production. As to the insensibility of the teeth in their healthy state, we know nothing to allege against their vitality, for we acknowledge in man diverse white tissues, which only have the property of feeling when in a pathological state.

Besides, this insensibility of the teeth is not as absolute as one generally believes ; for all, in recognising that the very distinct perception of the sound of a watch placed between the teeth is the result only of the sonorous vibrations communicated by the teeth to the jaws, by these to the skull, to the labyrinth, and from thence to the brain ; one cannot deny, however, that they are susceptible of receiving certain impressions, and of transmitting them to the *common sensorium* ; cold and heat,

carried to a certain degree, affect them disagreeably ; finally, we are able, by them, to know the qualities of certain bodies, which are accidentally placed in contact with them, that which we would be unable to do by artificial teeth, of whatever nature they might be.

We well know, although, to explain the impressions of heat and cold, and the sensations resulting from mechanical action received by means of the teeth, it is said that they first act upon the nerves and vessels of the dental pulp, to which they are transmitted across the thickness of the crown, and that the second are communicated by the membrane which envelopes all the length and each division of the root. But this explanation, satisfactory at first, ceases to be valuable when we reflect upon the tenuity of the dental pulp, especially at an advanced age, and upon the thickness of the two calcareous layers of the crown. Thus Beclard,* in these days, seeing the insufficiency of this explanation, said that, "*the crown of the tooth is formed of an organic animal matter, which one could not believe vascular.*" It were nearly as well, as every one perceives, to admit that it is sensible.

Still later, Blandin, acknowledging that the dental osteoide possesses, in its superficial layers, a peculiar sensibility, accompanying certain caries,† commencing between the enamel and ivory, &c. &c., has thought that it might be possible that this sensibility was inherent in the greyish line, intermediate between the ivory and enamel, that Cuvier believes it formed by a prolongation of the internal lining of the follicle, and in which some one of the nerves remains, that this lining possessed before having been taken between the two substances of the tooth, even at the moment of their formation.

Certainly, if it was thus through it, the instantaneousness of the phenomena of teeth set on edge would be understood more

* *Dictionary of Medicine*, vol 6, article Teeth.

† This fact presents itself so often to the observation, that we cannot conceive how Lemaire could have declared that, in diseases of the teeth, the pain manifests itself with violence, when a part of the substance of the crown being destroyed, *as far as the cavity*, the pulp was discovered.

easily, since, in this manner of viewing it, the acid which produces it would have need only of imbibing the enamel, a substance little thicker, and thus it might act nearly at the point of contact. But this explanation is a pure hypothesis, for there is little logic in inferring from the sensibility the existence of a membrane which has long since ceased to be, and whose former existence is affirmed only from a linear mark; this might cast in the shade the inherent properties of the body which produced it; in a word, realise a pure chimera.

Is it not, then, more reasonable, and more conformable to that which daily observation demonstrates, to admit, that of all parts of the teeth, the enamel alone is deprived of life, and consequently insensible; that the ivory, essential production of the papilla, is united to it by relations foreign, and contact too intimate not to receive, under some form, even inaccessible to our senses, a part of the agents of its excessive vitality? All the question relative to the presence or to the absence of vessels and nerves of the ossiform part of the teeth are summed up in these: the teeth have three distinct parts in them; the central organ or the pulp, which is essentially the nervo-vascular part, and consequently the most vital; the ivory, which protects this pulp, and which, although less sensible, is sufficiently so to avert the presence of hurtful agents; finally, the enamel, absolutely inert, which is there only to protect the other two substances from all attacks of strange bodies.

There are, as for the rest, from our own experience, numerous facts, which appear to us most conclusive in demonstrating not only that the ivory is not insensible, but that it possesses a sensibility sufficiently marked, and which it exerts even promptly. Let any one introduce into the cavity of a tooth, newly extracted, entire and provided with a central canal still very marked, a little stem of wood or of iron, colored with blue turnsole, and let the crown of that tooth be touched with a pencil impregnated with some acid; if the instantaneous setting on edge which follows the application depends, as it is commonly said, and as all the world has formerly believed, upon the action upon the dental pulp by that acid, which suddenly imbibes all the ossiform part, that action will be perceived by the blue color which has filled

the canal and turned it red. Well, this does not suffice, for it is a long time before this color is affected by the acid. We have even held the crowns of teeth, whose canal we had filled with a purple fluid, plunged in vinegar, (acetic acid weakened with water,) many minutes, with this liquid becoming reddened. Then the setting on edge has its seat primitively in a part situated less deep than the pulp, and which could only be the ivory.

Our opinion, as is perceived, has the double advantage of rendering as satisfactory account of the physiological phenomena of which the teeth are the seat, and of avoiding the whimsical contradiction into which the most of authors have fallen, which, after having strenuously denied all traces of the organization of the dental osteoide, they please, nevertheless, to describe the diseases by which it is so frequently affected, and of which development no one could logically explain, except by the laws of general vitality.

CHAPTER III.

DENTAL HYGIENE AND ORTHOPEDIA.

WE have hitherto been occupied with the anatomical and physiological facts which constitute the science of the surgeon dentist. But here commences his real art ; for we are about to describe, under the name of dental hygiene, a methodical exposition of all the cares and precautions which are intended to facilitate the development of either dentition, or to preserve the teeth in a constant state of health and cleanliness. We will append to this chapter, under the name of orthopedia, and in accordance with the true acceptation of the word, now much used and well understood, a series of means which, although requiring the application of the hand, cannot, nevertheless, be properly considered as operative surgery, inasmuch as they address themselves to conditions which, properly speaking, are not diseases. Such are the straightening, shortening and separating of the teeth : matters with regard to all of which we are about to announce precepts which are rational and of easy application.

SEC. 1.—*Of the Means of Directing the Eruption of the Teeth, and Facilitating their Arrangement*

First Dentition.—If we must believe the most of the authors who have written upon the diseases of children, during the last century or early part of this, or even of the dentists who, in our day, have published special treatises under the influence of the opinions of these authors, the eruption of the teeth, (particularly of the first dentition,) although performed in the order we have described in the preceding chapter, is an epoch so fearful that few children can pass through it without being assailed by dangers, capable at any moment of destroying their life.

But when we take the trouble to study nature without prejudice, and, above all, to judge by the facts, we easily escape from the exaggerated opinion which makes us see a continual cause of death in the execution of a natural function; and, in a great number of cases, we find one of two things: either that the eruption is entirely unconnected with the diseases which attack children at this period, or that it often is but a secondary cause of their existence, by putting in action morbid causes, to which the organs, the seat of these diseases, are predisposed; which would equally have been effected by any other stimulant.

This exaggeration once perceived, we must not fall into the contrary extreme, by refusing to admit that the escape of the teeth from the alveoli is one of those processes which nature rarely undertakes without effort; an effort accompanied, almost always, by pain, and which may also, under some circumstances, be the direct cause or simply the index of accidents sufficiently serious to claim serious attention. The trouble resulting from it may even cause itself to be felt in every part of the economy, or at least throughout the whole extent of the two organic systems which predominate in infancy, those which preside over nutrition and sensibility.

But why is the cutting of the first teeth often a laborious function? Is it due to the piercing the gum, or the dilatation of the *gubernaculum dentis*, as we adopt the old or new theory of the mechanism of the eruption? Though, while replying to this question in the affirmative, we cannot render an exact ac-

count of all the morbid phenomena which may happen at this time, we are, nevertheless, compelled to adhere to the opinion, for it promises to explain, to a certain extent, the most prominent of these phenomena. We know, indeed, that the local inflammation arising from a laceration or a simple dilatation, might be sufficiently great to irradiate itself upon the mucous membrane of the digestive and respiratory passages, and their appendages, and give rise to discharges aphthæ, ophthalmia, and even otitis, which often appear, and it will suffice to bring to mind the nervous disorders which laceration of tissues excites, to explain the convulsive movements which may accompany laborious dentition. As the description of these different accidents, and the treatment appropriate to them, belongs necessarily to the province of general pathology, we will not consider them here: the dental surgeon is rarely called upon on such occasions, or if he is, it is only required of him to attend to the local conditions of the appearing tooth. Instead of uselessly swelling this work, by copying what belongs to treatises on general pathology, it will suffice us to remark that the particular constitution of each child has much to do with the occurrence of these accidents; that they occur most commonly during the eruption of the eight small molar teeth, that is to say from the second to the third year; that they are more common to feeble, delicate, badly nourished children, or those born of nervous parents, than to others; finally, that the most efficacious means of prevention are to accustom them from birth to the changes of atmosphere, to subject them to insolation, frictions, and all other means likely to counteract the nervous constitution so common to children born in large cities.

From the fact that the morbid phenomena just described cease, often instantaneously, in the midst of the greatest intensity, from the moment that the teeth penetrate the gums, which retained them, and compressed their pulp at the bottom of the alveolus, has arisen the precept to divide that barrier when it opposes too much resistance. This little operation, which is effected with the point of a thin bistoury, the blade of which is guarded with linen for the space of four millimetres from its extremity, will often succeed so immediately as to cause regret that it had been so long postponed. In some cases, unhappily, premature

and ill timed incisions close again without any advantage to the child, as M. Guersant, a physician who has, in our time, devoted himself very successfully to the diseases of children, has frequently observed; a fact which seems to justify the supposition that the tooth thus denuded is propelled less rapidly than others. It has also been remarked, that the incision of the gum has favored caries, either because the teeth had been scratched by the point of the instrument guided by an inexperienced hand, or because they had been exposed before the enamel had become perfectly matured, if we may be allowed the expression.

We must conclude, then, from all we have said, that while the incision may be a means approved by reason, and, in many cases, sanctioned by experience, we must not have recourse inconsiderately to a practice which the children always resist, and which frightens the parents. Before proceeding to it, we must be very sure of the imminence of the eruption, and the necessity of accelerating it; which may be ascertained when the tooth projects under the gum, and seems ready to break through it. In other cases, we may content ourselves with making the child chew some body of moderate resistance, or a hard body so polished as to lessen the danger of violent pressure.

A crumb of bread, a piece of liquorice root, or of mallow, answer, if there be tumefaction of the gums: corals, or pieces of ivory or crystal may be better, if the eruption be yet distant and the gum not swollen. Finally, general means should not be neglected, especially such as tend to lessen the excitability of the sanguineous and nervous systems.

But, we repeat it, it is especially in the wise application of hygienic principles that we must seek the means to prevent the storms which threaten first dentition, and reduce that function to that state of harmlessness which it ought naturally to present. Certainly, as a modern author rationally remarks, by the aid of these precepts, we will be more likely to reach the desired end, than by amber necklaces, serpents' teeth, and the crowd of amulets which ignorance and credulity confide in, and which some dentists, careless of the dignity of their art, have yet the wickedness to advise, or the weakness to authorize.

Second Dentition—Indirect Means to Prevent Errors.

The cutting of the second teeth, called teeth of replacement, permanent, or secondary, is surely always less painful than that of the primitive or temporary ones. But, although the remarks we have made with regard to the exaggeration of the dangers of the first dentition apply still more forcibly to the case of the second, it is not the less true, whatever may otherwise be the constitution of the child, that the part of the gum surrounding the tooth to be replaced is almost always slightly inflamed. This inflammation, which rarely proceeds without pain, and sometimes terminates by little local abscesses, does not confine itself to the mouth, for it sometimes, upon slight provocation, extends to the surrounding parts. We even encounter, at this time, inflammatory and nervous accidents which attest a shock communicated to the whole economy, and accompanied always by indigestion, to which, moreover, the obstacle which the loosening of the milk teeth presents to regular mastication, is a further inducement.

It is principally when the small molars, or molars of replacement appear, which happens at the tenth or twelfth year, that children experience a feeling of *malaise*, and general indisposition, which can only be properly attributed to the efforts of nature, occupied with the replacement of the temporary teeth. In the second period, or what may be called the third dentition, that is to say, at the appearance of the second and third great molars, though effected at an age when the system is in a better state to resist, we sometimes encounter very serious morbid conditions, as we ourselves have frequently observed.

As in these last cases, there is more reason to attribute the accidents to the resistance of the gums, than those which occur during first dentition; it is prudent to proceed, as promptly as possible, to incise the tumefied gums, and even useful to scarify the surrounding parts with the point of a lancet. But we must not forget that these means will prove altogether inefficient, if the accidents which accompany the eruption of the teeth depend either upon the too close pressure of the teeth upon one another, or upon the want of space between the coronoid apophysis and

the second large molar, impeding the wisdom tooth. Their extraction is then indispensable, unless the difficulty of getting hold of them shall determine the operator rather to remove one anterior to them, so that they may occupy its place. This is generally the plan adopted, as the following case, given in the clinique of Prof. Velpeau, and belonging to the particular practice of M. Toirec, will show.

Mad. R. experienced, two or three months after her marriage, a dull pain at the angle of the lower jaw of the left side; the pain soon extended to the median line. Some months having passed in this condition, and the pains becoming daily more acute, a rheumatism was suspected, and different curative measures were employed. After a consultation of physicians, Mad. R. was sent to the springs. After her return, still suffering great anguish, she came to consult me. The face was pale and contracted, the emaciation of the body extreme, the appetite gone. The calm of the night seemed to augment her despair. The teeth, examined with care, were sound, white and well arranged; the gums in their whole extent were of a pale rose hue; nothing gave evidence of the cutting of a wisdom tooth. Nevertheless, I directed my researches to that point. I made a deep incision upon the gum, behind the second great molar. A small sound introduced, discovered a hard, shining body, around which I could pass the instrument, except in front, where it was arrested. I did not hesitate to believe that there was a tooth, directed obliquely from behind forward, the crown of which, resting upon the neighboring molar, was arrested by the latter; nor did I delay to extract the second large molar, to favor the escape of the wisdom tooth. Gradually the suffering disappeared, and five or six days after the operation, she ceased to feel the slightest pain."

M. Blandin also has been called to remove one of these teeth, which, locked up in its alveolus, as it were rivetted by bone, had occasioned fistulous openings, against which all the resources of art had been exhausted.

Finally, one of the most striking examples of the tardy, slow and difficult escape of a wisdom tooth happened to one of us, who, being at Moscow in 1804, extracted from Dr. Saint-Marie,

then sixty-four years old, one of this kind of teeth, which he had but lately cut, and by which he had been incommoded, at different times, for more than thirty-five years.

Direct Means to Prevent Errors of Second Dentition.

We again see that there are pathological phenomena which signalize the replacement of the teeth, as well as those which appear at the epoch of their first eruption; to prevent these accidents, and apply to them suitable treatment under all circumstances, belong properly to general medicine. But the symmetrical arrangement of the teeth is especially the work of the dentist. What, then, are the means proper to favor this arrangement? Is it necessary, as some ancient authors, and many modern ones, have pretended, to take out early the primitive teeth, or rather to seek to preserve them until they naturally fall out?

It is difficult to establish, in this respect, a precept rigorously applicable to all cases. We may, nevertheless, say, in general terms, that unless it is evident that the primitive tooth is an obstacle to the appearance of that which should replace it, the extraction is, to say the least, useless. It is to extend the sphere of our operations, but not to respect physiological function. But in the case, on the contrary, where the tooth is a mechanical cause, hindering the permanent one from developing itself properly, or to place itself in its proper position, there is a further indication, an absolute necessity, to remove it; for by delay we expose the child to irregularity of denture, a deformity easier prevented than cured.

This operation has for a long time been opposed by the fear of removing, with the milk tooth, the germ of that of replacement; but this fear can now have no influence, except for practitioners who do not know that from the age of four and a half or five years, this germ is entirely ossified, and no longer touches the primitive tooth, whose root begins to disappear. This disposition, however, is subject to variation: hence we often see the crowns of permanent teeth push so exactly from below those to be replaced, that they are, so to speak, dove-

tailed into each other. We perceive how, in such a case, the evulsion of the milk tooth might be prejudicial, for it would almost infallibly cause the loss of the secondary one.

But, we repeat it, as much as it will be improper to temporize when there is indication, there will be equal impropriety in too much haste; for when many teeth are extracted before they are loosened, the temporary ones do not arrange themselves so properly, or level themselves so equally as they ought. Take away the four incisors; they are replaced; but those that appear, being larger than those which are lost, necessarily force the canines out of place, and dispose them to loosen too quickly. The small molars are taken away; those which should replace them, no longer finding the lateral resistance which the canine, as a guide, should offer, advance freely forward, and occupy its place; in such a way, that when the canine of the secondary set appears, finding no place for itself, it falls within, or more commonly without, the dental circle.

Another reason for objecting to the premature evulsion of the milk teeth, is that their presence may aid the enlargement of the alveolar circle, which, at that age, is yet much under its complete development. We nevertheless frankly confess, that in sound physiology we cannot attach to the presence of these teeth as much importance as has commonly been attributed to them, and for two reasons: first, because the milk tooth, arrived at the natural term of its fall, has no or almost no root implanted in the alveolar border, and is not firmly enough fixed to furnish the slightest point of support: the second, that already, as we have said, the germ of the secondary tooth is completely ossified, and occupies, in the thickness of the alveolar ridge, a space which the fall of the primitive tooth cannot diminish. Hence, Fox properly observed, "The advantage of extracting these teeth will depend entirely upon whether it is done at the precise moment when nature proves backward in effecting the absorption of the roots of the temporary teeth. To avoid operating unadvisedly, we must thoroughly understand the progress of second dentition, and observe exactly the appearance of the gums, which swell when a tooth is upon the point of piercing them.

We further quote from this skilful practitioner, who, without doubt, has discussed this question most ably :

“To aid the permanent teeth in ranging themselves in suitable order, it does not suffice to extract those which obstruct, for considerable time will always be required to enable the irregular tooth to resume its natural position ; often, indeed, it fails to abate its irregularity altogether. We ought, therefore, to examine the mouth of a child frequently, so as to be able to make the extraction opportunely. The absorption of the roots of the temporary teeth is sometimes performed so slowly that they do not loosen until the permanent ones have pierced the gum behind them ; in such a case, if the permanent molars have appeared some time before, and if there be engorgement of the gums behind the two permanent central incisors, we ought to extract the two temporary central incisors, which correspond to them, even though they be not loose. When the absorption of the roots of these incisors has been prompt, which often occurs, these teeth shake, and the child can easily remove them himself, a little before the appearance of the new ones. But often, though they be loose, they do not fall of themselves before the permanent ones appear ; in such cases it is useful to extract them, in order to give to those which ought to succeed them, the facility, of taking their proper place. If, as we might soon detect, the new teeth have not sufficient room to develope themselves, it will be necessary to extract the two temporary lateral incisors.

“Two or three months afterwards, or even later, it will be time to give attention to the central incisors of the upper jaw. If we find them loosened, it will be proper to extract them ; if they are yet firm, and the gums be engorged, they should also be extracted ; for if they be left in place, the permanent ones, which are ready to appear, will take an irregular direction, ugly and hard to correct. It will also be proper to extract the lateral incisors, to procure to the permanent central ones the space needed for their development, but this should not be done until it is time for the latter to pierce the gums. Afterwards, the lower jaw should be attended to, when the incisors should appear at the end of three or four months. If we perceive any swelling of the gums through which they must pass, we should

extract the temporary cuspidati; three months afterwards, at the furthest, we must examine the upper jaw, and if we perceive that the permanent lateral incisors give signs of near appearance, we should also extract the temporary cuspidati.

"After this, the jaws will often require no further attention until the end of a year, when the incisors are entirely developed. After this, the cuspidati and bicuspidates are ready to appear; then we must be on our guard, to prevent the first taking an irregular position. We must examine the gums, and if they are prominent, we should extract the first temporary molars; these often are loosened, (Fox might have said most generally,) before the appearance of the cuspidati, which follows hard upon their extraction. Some circumstances should exercise much influence over the manner of treating these latter teeth. If, when one or the other of the cuspidati is ready to appear, we perceive that there is only a small space between the lateral incisor and the first bicuspid, already in its place, we must be careful to extract the second temporary molar. The bicuspid will then fall back, and give the cuspidatus a sufficient space.

"After this last operation, there remains no further obstacle to second dentition. The second bicuspidates come naturally into their proper place, and the molars, encountering no opposition, successively occupy their proper position."

SEC. 2.—*Of the Different Means of Preserving the Teeth.*

When the teeth naturally occupy their assigned places, or have been artfully conducted to them in the mode which we shall soon describe, it is necessary to watch their condition and preserve their health. So many causes are continually acting to alter them, that it is not surprising that it has always been felt necessary to preserve their health by care. Hence we find, in all the works on medicine, ancient or modern, judicious advice for their preservation, and if we consult general history, we will find that many people have attached so much importance to their preservation, that they have made it a part of legal requirement, a religious precept. Some savage tribes, in that depravity of taste which accompanies ignorance and barbarism, have sub-

jected their teeth to horrible mutilations, outraging nature in their efforts to adorn it; but all civilized people, with whom the cultivation of the arts has proven that the beautiful is allied to the good, have all agreed as to the importance of a healthy and regular mouth to an agreeable appearance; and the kind of care necessary to the different organs it contains.

The preservation of the teeth, as of all parts which compose the body, depends evidently upon two kinds of care. The first is general, that is, does not regard the teeth except as they are affected by laws regulating the entire economy; the others are special and particular, that is to say, exclusively applicable to them. Let us first examine the former, confining ourselves to what is particularly connected with our subject.

General Cares.

The choice of food is certainly the first of the precautions which any person who values his health, and consequently his teeth, should observe. But it is impossible, in a work such as this, to trace precise rules for this selection. For the constitution of each individual being the first thing which he should consult, it is evident that the best aliments for him will be such as tend to moderate the tendencies of his temperament to disease.

We may, nevertheless, say, in general terms, that animal food is less favorable to the preservation of teeth than vegetable diet; and this for two reasons, first because animal food conveys to every part of the system exciting principles, which no organ, the teeth no more than others, can well sustain in excess; secondly, because it is difficult to remove from between the teeth the residue of meats, the presence and decomposition of which is a cause of local alteration.

The abuse of green fruits and other acid substances is hurtful to the teeth; alcoholic liquors also do harm, if not through their chemical action, yet because they inevitably keep the gums and mucous lining of the digestive organs in a state of excitement, which the teeth will assuredly suffer from.

It is a matter of observation, that all food which contains sugar is injurious to the teeth. To explain this, we may observe,

that when alone and under a solid form it acts as all powders of a gritty kind ; and when in syrup or otherwise dissolved, it runs under the teeth, subjects them continually to the action of air, and makes them the seat of a morbid susceptibility, which may be the prelude to caries. The sensation (setting on edge) which it produces with many, seems to be explained upon this hypothesis, and indicate the necessity of moderation in the use of this article.

Every body knows that the use of well-water rapidly injures the teeth, and what the chemical analysis of these waters would lead us to suspect, experience demonstrates. Indeed there are few persons, who reside in places where river water is inaccessible, who have not lost the greater part of their teeth before they were forty ; this is especially the case with women. For the same reason, persons resorting to mineral springs usually return with their teeth in bad condition. Waters containing carbonic acids, free or combined, are those which produce the most remarkable effects.

The composition of aliments is not the only thing to be regarded as influencing the teeth ; we must also attend to their temperature. Pains should also be taken to avoid the habit of cracking nuts, bones, etc., with the teeth, or of drawing corks with them, especially if they be badly planted and have long crowns, this longitude being in inverse proportion to that of the roots. As to the precaution relative to the temperature of aliments, it consists in not only shunning the two extremes, but passing rapidly from one to the other. Hence it is a bad habit to drink cold drink directly after soup. We may readily suppose that the rapid transition from a state of high excitation to the contrary, may dispose the pulp to inflammation.

“Next to aliment and air, clothing should most claim the attention of persons anxious to preserve their teeth. The most important precaution, so far as the air is concerned, is to avoid extremes of heat or cold, and especially the rapid transition from one to the other. Under the influence of the latter cause, the teeth may be altered in two different ways, directly or secondarily : directly, by the lively stimulation that the cold imparts to the vessels and nerves shut up in the dental canal ; secondarily,

rily, by the rapid suppression of the transpiration, which is thrown back upon the mucous membrane of the mouth, and from it upon the teeth, causing those inflammatory swellings of all the walls of the mouth, generally called "*fluxions*." It is principally in this way that we may explain the destruction of the teeth of smokers; for, as we have long remarked, it is not the pipe which hurts the teeth, as is generally supposed, for it only acts mechanically, but rather the cold air, which, penetrating the mouth, whose walls are moist, sometimes creates an inflammation of the dental pulp, whence may arise a caries, which commonly developes itself upon those which, from structure and position, are already inclined to that disease. The experience of M. Donni confirms our own observation as to the harmlessness of the fumes of tobacco as a chemical agent. In his excellent treatise upon the properties of saliva, he says, "It is true that tobacco communicates to the saliva a certain very sharp acidity, very unpleasant to those unaccustomed to it, but it does not render it at all acid, as I have fully convinced myself; hence we cannot say that smoking *alters* the saliva, since it still preserves its alkaline quality, and may still neutralize gastric acids," &c.

Women are indebted to their extreme impressibility, and to the fatally imperious yoke which our habits and prejudices impose upon them, for the sorrowful lot to be more exposed than we are to the sad action which the causes under consideration effect. They should never, if they would preserve their teeth, quit suddenly warm clothing for that which is thinner; never wash the head with cold lotions; never walk on cold ground with thin shoes, &c.

Among the toilet articles which may hurt the teeth, we may mention the several kinds of paints, waters and pomades intended to remove freckles, &c., from the face, or to color the hair. These cosmetics, almost all of them, contain astringent and even caustic substances, as antimony, bismuth, the hydrochlorates of mercury and lead; substances which act directly upon the teeth, to which they are carried by the lymphatic vessels, which, proceeding from the skin, ramify upon the buccal mucous membrane, enveloping the neck of the teeth, and

entering the alveolar cavity. Those who, from their position, are compelled to use these substance, ought, as far as possible, to confine themselves to such as are purely vegetable; if these are not harmless, they are at least less injurious to the teeth.

It has always been remarked, that persons living in low, wet places, near to lakes or marshes, as inhabitants of valleys, and those who reside in ports where the temperature changes frequently during the day, generally have bad teeth. As to workmen, constantly employed in factories where the air is continually charged with metallic particles or acid vapors, capable of combining with the constituent parts of the teeth, it is possible, if not to protect them completely against these pernicious emanations, at least to lessen the danger of them, by properly ventilating the rooms, and by inducing the workmen to wear masks, as Dr. Loude advises, furnished at the part corresponding to the mouth, with a number of little pieces of sponge, upon which the mineral or acid emanations may condense without entering the mouth.

Special Cares.

By pursuing the general precepts which we have just laid down, undoubtedly a great number of the diseases of the teeth may be prevented. But these will hardly avail, if we neglect the particular precautions, which are none other than the cares of neatness, which form the daily "toilette" of the mouth. These are simple, and hardly require to be named. But as people sometimes with the best intention suffer themselves to be led by a blind routine, we ought to omit no details which may lead to a proper appreciation of these daily cares.

As the milk teeth, for the most part, require no care, we may say that we need not accustom children to the toilet of the mouth until the eighth or tenth year; but after that time they should be taught to regard this as an imperative necessity, causing them to use, every morning, water, moderately warm in winter, and of natural temperature in summer. The use of the brush is, to say the least, useless at first, for it would only diffuse over the gums and teeth the mucosities collected during the night.

Pure water will suffice, ordinarily, until the fifteenth or eighteenth year; but after that, (and sooner, if any local affection or derangement of digestive or respiratory organs should taint the breath,) the water should be qualified with a few drops of some aromatic spirituous liquor, such as Cologne water. Afterwards, we should use some kind of dentifrice, with which we should rub, in every direction, not only the teeth but the gums.

Should this dentifrice be applied, simply by using a piece of cloth or a corner of a towel rolled round the finger, as is the habit of some who wish to simplify their wants? Certainly not; for the pressure of the linen must certainly amass and harden the tartar in the places where it is disposed to accumulate; that is to say, between the teeth and about their necks. Experience has positively established this fact, and pronounced in favor of the brush, which, if mounted properly, can be directed against the sides of the most distant teeth, can penetrate into the intervals which separate them, and rub them in all directions; especially since brushes are made in so many forms as at present.

The other means advised to fulfil the duties of the brush are entirely and properly abandoned; the sponge, not only because it produces, in many persons, a sensation so unpleasant as to be absolutely painful, especially when the teeth have lost some of their enamel, but because it soon gets hard in flattening upon the staff which supports it. The several roots, such as liquorice, and mallow, because, however prepared they may be, they either harden or soften, as they are exposed or not to moisture.

To avoid the inconveniences sometimes attributed to brushes, they ought to be of a force proportioned to the sensibility of the gums, and to the thickness and hardness of the enamel. It is also necessary that they be kept in a state of perfect neatness, and that they be renewed as soon as they begin to wear out, because they necessarily become harder as the hairs of which they are formed become shorter. As to the manner of using them, it consists in rubbing the teeth, before and behind, and to make the brush pass lightly from top to bottom, so as to cleanse the interstices as much as possible.

This little operation finished, the mouth must be rinsed again, to take away the buccal slime which the brush must have de-

tached, or the residue of the dentifrice if one has been employed. Simple water, cold or warm, as the season may require, will suffice for this purpose, but if aromatised liquids be required, as we have before said, a few drops of Cologne water or some elixir will answer.

Finally, we should always remember that after eating we must use a tooth-pick, to take away the particles of food which may remain between the teeth. In France, quills are generally used for this purpose; but in other countries, as in America, England, Italy and Spain, they use tooth-picks of flexible, tough wood. These have the advantage that, as their points are not very sharp, they are not so likely to wound the gum. They are also made of whalebone, tortoise shell, ivory and bone; but we should never use needles, pins, or other metallic bodies. After using the tooth-pick, which should be done carefully, the mouth should be immediately rinsed. This is a precaution becoming common in France, and which we cannot but approve. Whether this should be done at table or elsewhere, is a question of good manners which we are not empowered to decide.

Elixirs, Powders and Soft Dentifrices.

As the cleansing of the mouth with water, qualified by a few drops of aromatic spirituous water, generally answers every purpose, we have limited ourselves, in the preceding chapter, to recommending the use of the simplest preparations. But many persons, in whom caries has already produced ravages, or who smoke, or whose breath is impure, either from bad constitution or disease, require more powerful means. This necessity has led to the exercise of industry, which, unhappily, has too often resulted in injury to the public health. Therefore, though the composition of these dentifrices is rather a matter of materia medica or pharmacy, we may with propriety adopt the common usage, and give some recipes; indeed, custom has hitherto permitted dentists to keep an assortment of them, and furnish them to their patrons. We may only remark, with Gariot, that all the recipes containing a crowd of drugs, of analogous, and sometimes incompatible qualities, form fantastic mixtures, which are

not as useful as those obtained by mixing two or three substances of well known character.

Elixir proper for Morning Use, to Rinse the Mouth.

R Brandy of Guaiacum,	six ounces,
Vulnerary spirituous water,	do.
Essential oil of mint, rose or violet,	four drops.

Two or three drops will suffice to aromatise a glass of water. It suits persons whose mouths are perfectly healthy ; but such as have bleeding gums or strong breath may substitute the following preparation, to be used in the same way.

R Brandy of Guaiac. (prepared,)	six ounces,
Camphorated brandy,	four grammes,
Essence of mint,	six drops,
Essence of cochlearia,	six drops,
Essence of rosemary,	six drops.

Another Tonic Elixir.

R Ratany root,	four ounces,
Spirituous vulnerary water,	two litres,
Essential oil of mint,	four grammes,
Essential oil of orange peel,	six grammes.

Bruise the ratany root, infuse it for eight days in the vulnerary water, filter the tincture, and add the essences, previously dissolved in twenty-four grammes of alcohol.

Elixir known as Botet Water.

R Alcohol, at 33°		two litres,
Crushed cloves,	} each,	thirty-two grammes,
Cinnamon,		
Green anise,	} each,	sixteen grammes.
Cochineal powder		
Essence of peppermint,		

Dentifrice Powders, (Alibert's.)

R Magnesia,	six ounces,
Red shell,	one ounce,
Florence Tris,	five ounces,
Supertartrate of potass,	two ounces.

Maury's.

℞ English magnesia,	} each,	one livre,
Cremor tartar,		
Sul. quinine,		twenty grammes,
Cochineal,		forty-eight grammes,
Essential oil of mint,		sixteen grammes,
Essential oil of cinnamon,		twelve grammes,
Essential oil of orange,		eight grammes,
Muscated and roseated spirit of amber,		four grammes.

Messrs. Milne Edwards and Varasseur.

℞ Peruvian bark,	} each,	sixteen grammes,
Magnesia,		
Cinnamon,		four grammes,
Essential oil of cloves,		one drop.

This preparation we consider better than the two preceding. It is particularly good for persons who have spongy relaxed gums.

Mr. Lefoulon's.

℞ Equal parts of—

Cochlearia,	Mint,
Horse radish,	Pellitory,
Guaiacum,	Aromatic calamus,
Quinine,	Ratany.

It is evident that, in composing his powder, by uniting all the substances commonly regarded as odontalgic, M. Lefoulon has rather aimed to satisfy public opinion, than to accomplish any positive indication. None of these substances can cleanse the teeth, and the powder is much better qualified to inflame the mouth than preserve the enamel.

The English, according to a note inserted in the Journal of Pharmacy and Chemistry, August, 1842, often use the following preparation :

White chalk, well dried,	three grammes,
Camphor, powdered extremely fine,	one gramme.

This is intimately mixed and triturated, and preserved in a flask hermetically sealed.

We cannot but think that camphor, however small the quantity, must give the mouth a very unpleasant taste.

There is another powder, which not only whitens the teeth perfectly, but gives to the lips and gums a fine rose color, which lasts part of the day. We give it, assured that it no more degrades our art to descend to such details, than it does to describe the manner of making false gums, or to point out the unpleasant results to the physiognomy of losing one or two teeth.

℞ Red coral,	four ounces,
Sandragon,	one ounce,
Fine carmine,	five grains,
Lemon peel,	twenty grains,
White sugar,	sixteen grammes.

The advantages latterly derived from chlorine, as a disinfecting and discoloring agent, have led some dentists to introduce it into dentifrices. In however small quantity it may be, it acts upon the teeth; hence it should never be used more than two or three times, to take away the deep yellow color which the teeth of some persons present. M. Taveau has made it an ingredient of pastilles, which he recommends to smokers. Here is the composition of those which Magendie prescribes for the same purpose :

℞ Chloride of lime,	8 grammes,
Sugar,	280 grammes,
Starch,	32 grammes,
Gum adraganth,	4 grammes,
Carmine,	15 centigrammes.

Make pastilles of three or four grains; two to four to be taken within two hours.

Mr. Magendie advises, besides, for restoring to yellow teeth their natural whiteness, to rub them with a brush slightly moistened and sprinkled with the following preparation :

℞ Dry chloride of lime,	four grains,
Red coral,	eight grammes.

Opiates and Mixtures.

These preparations only differ from the powders, in that they are blended in a sufficient quantity of syrup or rectified honey

to make them soft and pasty. They have no advantage over the powders, except that they are less liable to be scattered over the toilet, and are more easily carried about; but they rapidly deteriorate.

Maury's Formula.

℞ Best honey,	two livres,
Calcined alum,	two ounces,
Extract of Peruvian bark,	one ounce,
Essential oil of peppermint,	sixteen grammes,
Essential oil of cinnamon,	sixteen grammes,
Muscated and roseated spirit of amber,	eight grammes.

Boil the honey to the loss of a third, color with a little alca-net, mix the extract of bark, and pass through a fine cloth. When almost cold, add the alum, and, when quite cold, the essences.

Upon the plan of these dentifrices is composed the water which bears our name, (Desirabode water,) and which a ministerial circular, dated Nov. 13, 1838, places particularly among the preparations permitted to be sold, as innoxious.

We may here observe, that the employment of elixirs charged with resinous and balsamic matters, is preferable to powders and electuaries. These latter being composed of pulverized matters are rarely so thoroughly incorporated as to prevent the inconvenience resulting from their interposition and continuance between the teeth and the gums.

As most powders which enter into the preparation of dentifrices, are composed of acid salts, which may rapidly affect the teeth, a distinguished chemist has suggested to substitute alkaline salts for them. He has, therefore, under the somewhat far-fetched name of odontine, presented to the public an electuary, or rather a soap, composed very simply of the sub. carb. of magnesia and cocoa butter. The academy has been a little too fast, it seems to us, in patronising this preparation, for the action of alkalies ought to affect the enamel, if alkaline waters have the power ascribed to them of dissolving urinary calculi, and if drinks of the same kind hasten the solution of gouty concretions. We will also say, that the idea of composing dentifrices with

alkaline salts did not originate with Pelletier nor M. Oudet, who claims the suggestion, for, before 1836, Dr. Donni had pointed out Mr. Blondeau, pharmacist, as having tried such preparations.

Whatever be the elements of these preparations, the greatest pains should be taken to powder well all the hard substances which compose it, to reduce them to an impalpable powder; they should be thoroughly commingled, for if this precaution be not taken, they will not only be disagreeable, but may injure the teeth by their physical qualities.

Many persons endeavor to accomplish the end for which these preparations are intended, by cleansing the teeth by many simple substances which are commonly at hand, as carbon, soot, salt and snuff.

The antiseptic property of charcoal has occasioned it, for a long time, to be regarded as among the best dentifrices; its employment is yet popular, but by no means deserves the preference given it; for, if it be only partially powdered, it always wears the teeth more or less, and, if it be very finely levigated, it insinuates itself between the external wall of the alveoli and the gums, to which it lends a violet transparence. We have sometimes been obliged to detach the gums in order to favor a hæmorrhage, which might wash out the particles. We do not deny that charcoal has some antiseptic quality, which may render it useful to certain persons, especially to such as have soft and bleeding gums.

Table salt cannot be used with perfect safety, because it acts like other powders; besides, it is composed of soda and hydrochloric acid, whose action cannot be nugatory in the whitening of the teeth. Its employment also occasions abundant salivation, which, though useful enough in some circumstances, is foreign to the end we have in view at present.

As to soot, its employment as dentifrice depends only on the fact that some persons, misled by the apparent whiteness of the teeth of sweeps, have supposed that they could obtain similar results by the use of this substance. But, besides being very uncleanly, and imparting a very unpleasant taste to the mouth, it communicates a very yellow or brown tint, which it is almost

impossible to remove, and which is not perceived in sweeps, owing to the habitual blackness of their faces. The following is a formula of which soot is the basis, and which is lauded by Dr. E. Kemmerer.

℞ Powdered wood soot,	one ounce,
Powder of strawberry plant,	five drachms,
Cologne water,	several drops.

What we have said of the inconveniences of soot, also applies to snuff, whose usefulness is too doubtful to compensate for its filthiness; and to Peruvian bark, the tannin of which must, in the long run, tarnish the teeth. Nevertheless, as the powder of cinchona enjoys an evident tonic quality, we may sometimes combine it with other substances, for the purpose of forming a dentifrice, useful under certain circumstances. For example,

℞ Powdered charcoal,	two ounces,
Peruvian bark,	one ounce,
White sugar,	two ounces,
Oil of mint,	one drachm,
Oil of cinnamon,	thirty grains,
Muscated and roseated ess. of amber,	nine grains.

SEC. 3.—*Of Tartar, and the Means of Removing it.*

In subjecting the mouth, early, to the rules of cleanliness, and to different hygienic precautions, which we have described with a minuteness that will not appear excessive, except to dentists who have never considered the importance of it. We assuredly place the teeth in the condition most favorable to their preservation; but to obtain their full efficacy, these precautions should be regular and continued.

If discontinued a short time, the teeth lose their lustre, and become encrusted with a calcareous yellowish matter, called tartar, a hard coating, which, if left to itself, does not fail to loosen them, by detaching the gums, introducing itself even to the alveoli. It sometimes forms considerable masses, completely encasing the teeth, and causing them to appear as entirely blended. Hence we may remark that some have been too rash to conclude that the examples reported by the ancients of the teeth

being apparently soldered together, were not correct. This premature opinion is like many others which modern presumption leads us to entertain with regard to the experience of our predecessors. Recent facts confirm the account of these apparently conglomerated teeth.

The physiological history and chemical composition of tartar have long occupied the attention of authors, who have written upon our art, or upon some of the sciences upon which it is based. Until lately it has been regarded as a deposit of earthy salts, precipitated from the saliva by chemical affinities, and deposited gradually upon the teeth, where it is attached by the mucus of the mouth. But M. Serres thinks that it is secreted by glands contained in the gums, and M. Delabarre regards it as a noxious exhalation from the mucous membrane which covers the gums: two opinions originating in love of innovation, rather than assurance of truth. For, if we may overthrow the one, by remarking that no such glands exist, or if they do, only in children, who are little subject to tartar, we may reply to the other, with equal force, that the teeth of healthy people are as subject to it as those of invalids. We must, therefore, adhere to the old explanation, although it does not explain why some are more subject to it than others, although exposed to the same circumstances.

The chemical analysis of tartar sustains this opinion: being made Dec. 31, 1825, by the celebrated Vauquelin, aided by M. Langier, it has shown tartar to be composed

1. Of animal matter, different from that of the bones.
2. Of organic matter.
3. Of phosphate and carbonate of lime.
4. Of a brown matter, resembling oxyd of iron, and formed of iron and phosphate of magnesia, viz.

Phosphate of lime,	-	-	-	-	-	66 parts,
Carb of lime,	-	-	-	-	-	9
Phos. of mag. and oxyd of iron,	-	-	-	-	-	3
Mucus,	-	-	-	-	-	14
Water,	-	-	-	-	-	7
						99

We know that the mucus of the saliva (the only part which can furnish tartar) when burned, will yield much calcareous phosphate, and a little phosphate of magnesia.

Berzelius, some time before, had found it to contain as follows :

Earthy phosphates, - - - - -	79 parts,
Undecomposed mucus, - - - - -	12.5
Peculiar salivary matter, - - - - -	1
Animal matter, soluble in hydrochloric acid,	7.5
	100.0

But the most important question for us is neither its origin nor chemical qualities ; we are more concerned about the harm it does to the teeth, and the gum corresponding to them. We may first observe that it collects principally upon the six anterior teeth, more on the inferior than superior ; it sometimes appears only as abundant slime, but ordinarily it forms a hard, greyish-black body, or a thick yellow crust, which gives the teeth the appearance of petrified bodies. It is more abundant upon the side of the mouth which, from any cause, is least used in mastication, and in the case of persons compelled to live upon soft food. Smokers are also very liable to it. We have, in our possession, masses of it of extraordinary size and shape.

The inevitable effect of the tartar is to prevent the action of the air upon the teeth, and in certain cases to soften the enamel, and favor its disappearance. When it thus finds itself in contact with the bony structure, it irritates and inflames it, and produces a caries, the ravages of which are rapid in proportion to the denuding of the ivory. Insinuating itself soon between the neck of the tooth and the gum, it destroys the attachment, loosens the tooth, and so diseases the gum as to cause it to secrete fetid matter.

Tartar, once formed, never disappears spontaneously. In most cases, it can only be removed by instruments, against which there is great prejudice. Simple and easy as the operation may be, it nevertheless demands address and certain precautions, which are soon learned by practice, which may, however, be reduced to rule, as we will do as briefly as possible.

The first care the dentist should take, which, indeed, applies

to all his operations, is not to begin until he has disposed at hand all his instruments and accessories, such as brushes, towels, warm and cold water, and a flask of elixir. The necessary instruments are scalers, gravers and crotchets. They ought to be very clean, made of fine steel, very highly polished, sharp and firmly fixed on their handles, so as not to be dismounted during the operation, which would cause the loss of time, and fatigue the subject of the operation.

The operating chair should be so heavy as to prevent its tilting, of such a base as renders it firm, and of a form convenient for resting the arms, and for affording the head a soft reclining plane, slightly leaning backwards. It should face the light. About to begin, the dentist should, as in all similar cases, wash his hands, so as to remove any disgust which placing his fingers in the mouth might create. This being done so rapidly as not to give it the importance of a serious matter, he should place upon the back of the chair a napkin to cleanse his instruments.

Occupying the right of the patient, but behind her, he passes the arm around her head, and taking a scaler, proceeds to operate upon the lower incisors. The lower lip, being abased by the thumb of the left hand, and forming a fulcrum to the ring finger of the right hand, he makes the cutting edge of his instrument to pass below the tartar, breaking it in pieces, working from below upwards, so as to avoid wounding the gum. The anterior surface being thus cleansed, he uses a thin, flexible blade, dull at the extremity and passes it between the teeth like a tooth-pick. He pushes out the accumulated tartar, which, by its presence, acted as a wedge. The operator then proceeds to the internal surface, and for this he causes the patient to lean forward, the lower lip still pushed down by the thumb of the left hand, but the ring finger of the right being applied to the crowns of the incisors and canines. Then he removes the tartar, always working from below upwards, either with crotchets or scalers, ended with thin facets, acute-angled, and with cutting edges. We may remark that, as it is very difficult to see the tartar in this position, it is often necessary to use a small oval mirror, the case of which is well guarded, and which serves both to exhibit the parts and push back the tongue.

To operate on the teeth of the upper jaw, the dentist, always keeping his left arm around the patient's head, with the index finger of the left hand lifts the upper lip, the thumb of the right applying itself to the cutting edge of the tooth next to that to be cleansed, and the thumb and index holding a sharp scraper, cutting near the extremity, he raises, breaks and detaches the tartar from the teeth, causing it to follow the contour of the gum. The scraper answers for the eight or ten anterior teeth, but for the large molars the lancet and scaler are preferable. As to the internal face of the upper teeth, it should be examined, but it is rarely covered by tartar. The continual movements of the tongue ordinarily detaches it as soon as formed. If it existed, the round ended scraper or the crotchet would be the proper instrument for removing it. When cavities are filled with tartar, unless we prefer to plug them, we should permit it to remain, especially if it be in sufficient quantity and is solid enough to fill the cavity.

It is hardly necessary to observe that during the operation we should repeatedly cause the patient to rinse her mouth, not only to facilitate the expulsion of detached tartar, but also to afford an opportunity to relieve a fatiguing position. We would not mention the utility of a brush in cleansing the teeth, were it not necessary to observe that a dentist should have brushes of various forms ; straight for cleansing the teeth without ; curved to act upon their inner surface. When the teeth are abundantly charged with tartar, it is sometimes proper not to cleanse them completely at a single sitting, and this especially in cold weather, for the teeth, suddenly deprived of this kind of calcareous envelope, acquire a sensibility which, in nervous subjects, may be very painful. When there is no urgency, the time of operation should be fixed when there is little to fear from atmospheric variation. By not taking this precaution, and many others which good sense indicates, but the details of which would be tiresome, we may authorize persons whose mouths have been cleansed to accuse our instruments of causing pains of which they were altogether innocent.

Finally, to conclude what belongs to the daily care of the mouth, and the cleansing of the teeth, we may observe, that in

spite of all these precautions, they will sometimes acquire a yellow hue, which may be natural to them. We would act very imprudently if, in such cases, we should endeavor, by instruments or any other agency, to procure whiteness and brilliancy for them; because, in many cases, we would not succeed, and if we should, it would be at the expense of the enamel. Let us observe, also, that this yellow hue is sometimes the proper product of age, against which all remedies are vain.

SEC. 4.—*Of the Means of Remedying Irregularities of Dentition—Vices of Conformation dependent upon the Teeth.*

In describing, with all necessary minuteness, the cares necessary for the preservation of the teeth, we have admitted that they were regularly arranged; but, whatever care we take to favor this arrangement, it happens but too frequently that they persist in taking a wrong direction. Our art is not helpless under such circumstances; it is only necessary to be well persuaded that the success of our means will depend much upon the circumstances under which they are employed. As to the nature of these means, they are far from being, as some recent writings would inculcate, modern discoveries. There is not a dentist who has practiced for thirty years, who has not employed, every day, the very means now in use; and if some practitioners seem to make this a subject of particular attention, this is rather the result of enlightened public opinion, which better appreciates these things, than of anything they have added to former knowledge.

The irregularity of the teeth depends either upon their deviation, their formation or implantation. Each of these vices may be carried to the extent of true deformity. Let us first examine vices of deviation.

These irregularities are commonly known as obliquities. The obliquity may be forward, backward, laterally, or by rotation, according as the teeth which constitute it are directed outward or inward, mount upon the faces of their neighbors, or have undergone such a movement that one of their sides presents forward, and another posteriorly.

The primitive or temporary teeth rarely exhibit these deviations, and when they exist, they are generally so little important as to be unworthy of attention. As to the secondary teeth, the incisors and canines are most frequently thrown out of their proper place, which is readily enough explained by the fact that their roots being single, and occupying less space in the alveolar border than their crown does beyond it, they are more exposed to forces which may be brought to bear upon them.

It must not be supposed that any great force is necessary for this purpose. It only requires a slight default of antagonism between two powers in the midst of which the teeth are placed, that is to say, between the lips in front and the tongue behind. Do we not perceive that, in almost all cases of hare-lip, the teeth corresponding to the fissure, throw themselves forward; and that the operation which cures this deformity also replaces the teeth? This is an important fact, which goes far to enlighten us upon the choice of means proper for replacement.

If we study the causes which produce these deviations, we find it sometimes in an organic malady of the alveolar border; but the more common cause, as we have already said, is the defect of relation between the size of the teeth and the space they ought to occupy; the tardy shedding of some primitive tooth; the presence of a tooth trespassing upon the space proper to another; finally, the existence of a supernumerary tooth, which we have called a surplus tooth.

Art has two kinds of means of remedying obliquity: the first act slowly, continuously, and are incapable of occasioning the least accident, or even the slightest pain: the others, on the contrary, act promptly but painfully, whence they would be abandoned, even if there were not other peculiar inconveniences attending them.

The first of these expedients consists in bringing back the distorted tooth into its proper place, by the aid of traction exercised upon it by ligatures, which have their point d'appui upon the neighboring teeth; but two conditions are necessary: there must be sufficient space to receive the tooth, and the tooth which forms the basis of support to the traction must be more firmly fixed than the one to be moved.

As many persons doubt the success of this proceeding, it is proper to observe, that the tooth to be removed does not represent an inert force to be overcome, but an active force, the direction of which should be changed. Let us reflect upon the facility with which the most firmly resisting of our tissues yield to the action of slight forces when long continued ; and we will perceive that there are few cases in which a simple lever, skillfully used and firmly fixed, will not suffice, especially in young subjects, to replace a tooth, however distorted it may be. Every thing depends, in these cases, upon the address and judgment of the operator.

But should we have threads alone, reckoning upon their own elasticity, or only use them as means of attachment? We believe that threads have rarely the power supposed, and experience shows that they are fraught with great inconvenience. In the first place, they loosen the teeth around which they are thrown for support ; and again, they strip these as well as those to be moved, and act too near the neck.

We know that, to obviate the loosening of the supporting teeth, those are chosen which have stronger roots than the irregular teeth ; and that to prevent the ligature from gliding under the gums, use is made of a small hook, one of the curves of which fits upon the cutting edge of the tooth, while the other holds back the ligature. But, on the one hand, the form of the roots is too variable to permit us always to calculate upon their respective forces ; and if, on the other hand, the hooks applied upon the teeth prevent the thread from slipping, they are means which always impede the action of these last, and hinder it from being direct.

Thus, then, if we would act with certainty, we ought rarely to confine ourselves simply to ligatures. There being a certain resistance to overcome, as must be the case in patients somewhat advanced in age, we may augment the power of the ligatures by combining their action with those of different apparatus, commonly described under the name of plates or bands. These are a kind of metallic springs, narrow and thin, adapted to the contour of the alveolar border, and applied in front or behind this border, according as the irregular tooth has deviated forward

or backward ; but better still, a double band, which gives to the thread a surer support, by hindering it from gliding upon the crown of the tooth, especially towards the neck. In order to explain their action and the mode of applying them, we will cite an example : Let us suppose an incisor thrown forward and having space enough to permit it to be reduced into line. We take the mould of the defective dental arch, as it will be described in the "*prothesis*." Then, upon the posterior and anterior faces of the teeth, we adapt a bandelette of gold, somewhat less wide than the height of the teeth, but touching them all in the direction of the alveolar border, terminating at each of its extremities by a kind of bracelet, or better still by a true cap, which envelopes the two last molars, upon which we wish to take a firm support. Before applying this little apparatus, we pierce each bandelette with two holes in the same horizontal direction, and precisely at the point corresponding to the irregular or oblique tooth. Finally, when it is applied, we pass through the holes a thread of raw silk waxed, or of platina, and twist them round the tooth to be replaced.

This apparatus, which is the only one we employ, as it is much more sure than the simple thread, has this advantage, that its action is constant. This continuousness results from the incessant action of the spring reacting upon the thread. The power may be increased by so arranging the spring that it shall not touch the teeth which form the sides of the vacant space to be filled by the tooth to be retained. We have cited the simplest case in which the band is applied ; but it is easy to perceive that it might be used upon several teeth as easily as upon one. It is only necessary, in complicated cases, to pierce the bandeau with as many holes, and pass through as many ligatures as there are irregular teeth.

Whatever modern authors may say of the means we have described, claiming it as their own invention, and supposing, upon the ground of some modifications, that they have "resolved a problem never before thought of," it is nevertheless true, that it was known to the ancients. A detailed description of it may be found in Fauchard, and if our predecessors have not derived as much benefit from it as ourselves, it was because they did

not avail themselves of firm points d'appui, a first condition in all apparatus of replacement.

When one has become familiar with the mode of applying bandeaux, formerly called plates, and which are nothing more than springs, he will perceive that they are only applicable to anterior and posterior displacements; but generally simple ligatures are used to correct lateral and rotated obliquities. In the first case, the thread is firmly fixed upon the last or even the two last molars of the side opposed to the deviated tooth, and we tie it upon the latter, causing it to pass in front of the neighboring teeth, when the tooth presents inwardly, and vice versa. This direction of the ligature exercises less traction between the two lines which the tooth must traverse in order to reach its place, for it is evident that if, in a case of inward lateral obliquity, of an incisor for instance, the thread departed from the inward face of the molars, it would only draw backwards, but not into the vacant space to be occupied.

As to rotary deviations, they are generally corrected by surrounding the tooth with a strong silken thread, one of the ends of which is carried inwards, the other outwards, to be fixed upon the last molars. As these teeth, especially if they are incisors, leave sufficient scope, by the very fact of their movement, to the means to be employed for their restoration, we surround them with a little ring, which embraces them exactly, and bears in front and behind a small hook, into which the thread is received to go to fix itself upon the molars of each side, either directly or by the intervention of a little cap placed upon these latter, or a small ring upon which the thread may be tied.

Generally, by these and similar means, we may succeed, in less than a month, in restoring a tooth to its natural place. In the course of treatment, the ligature must be changed and re-adjusted every three or four days. When the desired end has been obtained, we sustain the tooth for one or two months, or more, by means of a smaller ligature or a gold thread, until the alveolar border shall have acquired sufficient firmness to maintain the tooth in the direction given to it; but what is yet better is to cause the patient to wear at night a kind of metallic capsule, fitting exactly upon the teeth, and enclosing not only the restored tooth, but those surrounding it.

We may perceive the importance of this, if we remember the intensity with which the jaws are sometimes clenched at night. We have seen this so strong as to displace artificial pieces, when inconveniently arranged. It is well to take another mould of the mouth after the success of an operation of this kind, as, by the comparison of this with the previous mould, we may the better judge of the result in all its extent.

We have remarked that besides ligatures there was another way to restore a deviated tooth to its natural direction. This means is incomplete luxation. As it is not without danger, it should never be tried except when the inefficiency of ligatures is well established, as in the case of an individual twenty or thirty years old, in whose case one or two teeth should project within the alveolar border. If the operator concludes that the space destined for the distorted tooth is not large enough to receive it, he will file away the adjacent teeth and the displaced tooth, until the necessary size is obtained, when he will luxate the latter, and restore it to its proper position.

Pincers will ordinarily suffice for this purpose ; but, in order to success, it should be done with all possible care, and all effort should cease as soon as it is brought to the level of the others. It is then prudent to preserve it in its new place by ligatures. Some weeks will suffice, it is said, for the alveolar border to adapt itself intimately and render it as firm as before.

But, we repeat it, this manœuvre, which properly belongs to surgery, is not only of doubtful efficacy, but may be attended with disastrous consequences. It is indispensable, indeed, that in practising it, even with all possible care, we may not only break and tear the gums, tear the alveolo-dental periosteum, fracture the alveoli, but even break the tooth. Therefore, we have never undertaken it, and we advise all young practitioners to avoid it, or never attempt it until they have well balanced the chances.

We have all along supposed either that the space proper to the tooth remained unoccupied, or that room could be made by extracting a tooth. When, however, there is nearly sufficient space, it is not necessary to make such a sacrifice. The end can be obtained by filing slightly the sides of the displaced tooth or of those between which it is placed, as we have already said.

CHAPTER IV.

PATHOLOGY AND THERAPEUTICS.

OF authors who have written on specialities on our art, some, as Maury, holding no account of the relations of organization and of the end which unites the dental bone and its central ganglion, content themselves with dividing the diseases of the teeth into those which relate to *their hard parts* and those which effect *their soft parts*; whilst others, as Lefoulon, having no very just idea of that which they ought to understand as *diseases*, have added to the number of those of their teeth, simple *anomalies of form and of arrangement*. More logical in this respect than those, we have arranged the changes of the organs, which we shall now treat of into three distinct classes.

The first includes the vital or pathological changes properly so called, which are, injuries of the follicles; erosion or atrophy of the teeth; discoloration and decomposition of the enamel; consumption of the roots; caries and its different varieties; exostosis and the spinal ventosis; softening; inflammation; fungosity; ossification even of the dental pulp, and finally the different nervous affections of the teeth.

The second comprehends, on the contrary, *injuries purely physical*, as the wearing away, cracking and fracture of the teeth; their loosening, fluxation and denudation.

Finally we have arranged in the third class the *diseases of the auxiliaries of the teeth*, either the diseases of the gums of an inflammatory nature, or the diseases of the alveoli.

VITAL OR PATHOLOGICAL CHANGES.

Diseases of the Follicles.

For every attentive practitioner to return to the first origin of diseases, it is manifest that a sufficient number which effect the teeth can be referred to other causes than the disorders to which their follicles have been exposed. This circumstance has necessarily been overlooked a long time; for, to place it beyond doubt, two things are necessary which are rarely presented;

either that the alveoli were open when they contained only the follicles, or that later, when it is possible to penetrate the scalp with the hand into the interior of the gums, we will find there the follicles which precisely at this period have disappeared.

Oudet is believed to be one of the dentists who were first occupied with this important subject; for, in a treatise relating to this question, he relates as something new that, in many cases where the crown of the tooth still remained in its follicle, it offered signs of atrophy, he has found also many points of the internal membrane much redder than in its normal state.

We have proven this fact in later years and in many instances; from thence we desire this opinion, that we publish as a fundamental maxim, that a great number of changes to which the teeth are subjected are dependent upon an inflammation which at an earlier period has affected the internal membrane of the follicle.

A circumstance which goes still more to strengthen this opinion is, that we have many times met follicles whose cavities contained a purulent, yellow and thick matter, which could only have been the result of an inflammatory work, whose effects have inevitably made us sensible of a germ within, whatever may be the theory that we adopt to explain the formation of this germ.

It is even possible, in analyzing with care the writings of many ancient authors, Jourdain* and Bourdet,† for example, to find some traces, if not of the express opinion that certain changes of the teeth had primitively taken place in the follicles, at least of an opinion nearly analogous; for they admit that *many changes of the enamel depend upon the vicious qualities of the fluid exhaled by the internal membrane*. Jourdain quotes to this effect, many observations made upon individuals who have been attacked, either by putrid fevers, or varioloidal and scorbutical affections, and among whom he has discovered remarkable changes in the fluid of the follicles.

As one perceives, these observations are not altogether unim-

* *Treatise upon the Diseases and Surgical Operations of the Mouth*. 2 vols. in 8, 1756.

† *Researches and Observations upon every part of the Art of Dentistry*. 2 vols. in 12, 1756.

portant, yet one must not be too positive, still they are no less important, when one considers, in effect, the manifest correlativeness which exists between many changes of the teeth and the different diseases which have exerted a troublesome influence upon the development of the follicles, we cannot refuse to believe that the different secretions which have a place in the interior of them, and which preside at the formation of the teeth, exert a powerful influence upon the manner of which these dental bones will be organized. The same dependance in which we find the other fluids of the organization bear to these secretory organs, we find between the tooth and its follicle; in such a manner that the least cause which troubles the functions of the latter must necessarily be reproduced under the configuration of the first. This is a general law to which the teeth have never made a single exception.

Let us add to that, that the teeth once formed, and *deprived in part if not altogether, of the vascular elements*, would themselves only become the seat of a weak nutritive process, and consequently pathological; we hence perceive the great importance of these organs which have immediately contributed or only presided over their formation, and which constitute the natural bonds by which they were held dependent upon the organization of which they have received all of their injurious influences. Also, the ill health of parents, the diseases which attacked the mother during pregnancy or lactation, all diseases to the fœtus or child is subjected during the first or second dentition, do they effect the teeth only in acting upon their follicles.

As all these diseases might have a different degree of strength and intensity, as they might attack separately or at the same time the two secretory organs which enter into the composition of the follicle, the morbid effects which result ought consequently to vary. Thus, often, without presenting any sensible change, the texture of the teeth will become extremely delicate and weak, a disposition which is the principal cause of a premature destruction. At another time, we discover more or less injuries upon the surface of the enamel, injuries which are perceived at the time of the formation of the teeth, and showing that the internal membrane of the follicles had been diseased in several

parts of its extent; finally, in some instances, the ivory will be the seat of many changes which depend very evidently upon diseases to which the functions of the pulp have been exposed.

This truth once well established as a fundamental indication, let us examine successively the different diseases of the teeth, following for their description the eminently methodical order that we have heretofore adopted.

Congenital Defects of the Enamel.

Erosion or Atrophy.—If we were always obliged in order to form an exact idea of things, to search for the literal sense of words employed by us to designate them, we ought surely to understand by *erosion* only a change of the teeth caused by the action of an erosive agent, as an ulcer, and acid, and large file, and by that of *atrophy*, their defect of development, as we have before said; but dentists, for the most part such bad etymologists, have commonly described under these two names, a change of teeth *which depends upon a defect in the secretion of enamel.*

This affection is always congenital, that is to say, that it experiences no change after the formation of the crown, but is the constant result of a defective secretion of the internal membrane of the follicle, a little before birth. It then seems that nature has not sufficient force to form a sufficient secretion of enamel, and that it has been arrested in this work by causes difficult to be understood. The forms under which this change presents itself are very variable; we are able, however, to reduce them to three principal ones.

The first variety of atrophy of the enamel affects only the surface of this cortical envelope. It consists in spots of a milk white or of a yellow more or less deep, sometimes black. The spots, often irregular, do not injure the brightness of the enamel; they remain stationary, but nothing can make them disappear.

The second variety, the most common, consists in small irregular indentations, like pricks scattered irregularly here and there, variable in number, upon the different parts of the free surface of the teeth. Ordinarily very small, superficial, these

indentations form a rough surface which is a true *erosion*. They have often considerable extent and present facets; sometimes these furrows or depressions are circular in the form of gutters, which traverse the contour of the crown; or finally these transverse sinuosities are united or separated by projecting lines.

As to the third variety of *atrophy*, it differs entirely from the preceding, in this respect, it affects all the dental substance, but especially the enamel. In rigorous language, it merits only the name of atrophy; for it is a kind of modification, a sort of wasting.

In this variety, there is a loss of substance more or less great which occupies most commonly the centre of the external face of the crown of the exterior teeth or the triturating surface of the large molars. Often, then, the free extremity of the teeth is almost entirely deprived of enamel to a certain height, as if it had been plunged in a corrosive liquid. The incisors offer deep and irregular dentings, the canines are very long. The diseased tooth remains all entire by a decree of development; sometimes it is completely deprived of one of its constituent parts; so much so that its crown is reduced to two-thirds of its volume, so much so that it offers a circular depression, and even a true cavity. We have also remarked, that the roots of teeth thus disfigured offer similar sinuosities, projecting and circular lines, and that they were knotty and very short.

Atrophy is *idiopathic* or *symptomatic*. We meet the first among subjects of excellent health who have never been sick. It evidently depends upon local causes which have troubled the functions of the follicular membrane. The second is common among individuals who are in bad health, of a lymphatic and scrofulous constitution. The varioloid, scarlet fever, measles and different gastro-intestinal inflammations appear to have a powerful influence upon its development. Thus, whilst *idiopathic* atrophy affects only a small number of teeth and appears only in few parts, *symptomatic* attack ordinarily most of the teeth and causes great disorders.

As the different changes of which we are speaking might have a very variable intensity and duration, the depth, extent and number of lines traced by atrophy ought also to vary. Moreover they do not occupy, when many teeth are affected the same

place upon the crown; they might occupy the cutting edge of the second incisors and the triturating surface of the first molars; and thus in order. These differences evidently answer to the order of succession that agrees with the formation of the teeth, and might even seem to establish, in a manner sufficiently precise, the time at which the subject had been attacked with some serious disease. If, for example, the incisors are only affected, we are authorized to presume that the person had been diseased towards the first or second year; if they are, on the contrary, the small or the two permanent molars, the disease might have existed at the fourth or fifth year, a period at which the fourth and even often the six anterior permanent teeth have already their crowns entirely enamelled.

It has long since been observed that the milk teeth are much less liable to be affected with atrophy than the permanent; but they are affected by it, they are a sufficient number whose development is prevented by it. As to the permanent teeth, those which carry most commonly traces of this change, are the incisors and the first large permanent molars; the second large molars and the small of the same name, or bicuspides, next come under this relation.

We have until the present spoken only of erosion in the sense that most authors give to this change, they attribute it nearly always to a defective secretion of enamel. But erosion exists not less as a disease affecting this body consecutive to its formation, or, to be better understood, we say that independently of congenital defects of the enamel of the teeth, they might still, long after their eruption, find themselves at one instant deprived in many parts of their crown, of their vitreous envelope. This kind of erosion, that we shall name *consecutive*, in opposition to the first, is very common among young subjects exposed to affections of the digestive organs. Do the mucous fluids, in the midst of which the teeth bathe in these diseases acquire corrosive qualities sufficiently marked to explain its development? It is this that we are ignorant of, but the return of minds to the study so long neglected, will permit us to see the solution of this question. Let us remark, nevertheless, that we have often met consecutive erosion upon subjects attacked by

diseases occasioned by the presence of intestinal worms ; we had observed, some time since, an example of it upon a young girl attacked with epileptiform hysteria, and whose teeth had been perfectly healthy until the time of this affection.

When the depressions which we have remarked upon the enamel are light and very numerous, and this presents its natural color, they present really no deepness. But when they penetrate so deeply as to impair or deprive the tooth of a part of its enamelled covering, or where one part of the crown is destroyed, they constitute a grievous state, because they are the forerunners of decay.

As it is so difficult to make the different changes resulting from dental atrophy disappear, it is principally their causes that we should attack and combat with, either to prevent them or stop their progress. This indication, as we perceive, cannot be remedied, excepting by the observance of the rules of hygiene, of those whose end is to prepare a perfect set of teeth. If the change depends upon a general affection, we should direct all the efforts of therapeutics to the treatment of this last. In some circumstances, nevertheless, the aid of surgery would undoubtedly be advantageous. Thus, where the depressions occupy the free extremity of the crowns of the anterior teeth, they can be made to disappear by use of the file, being always careful not to wear away too deeply the tissue of ivory. If the crown is excavated in such a manner as to present a cavity of a certain extent, like that which generally happens to the large molars, the caries can be prevented by filling it with gold or silver leaf, or other substances, after having first cauterised the base.

Decomposition of Enamel.

The enamel can yet present changes of another nature, whose origin relates equally to follicular injuries. Amongst these changes, there is one very common—one which merits our attention, and which we have named, with Maury, *decomposition of enamel*. It manifests itself by brown or black spots, which develop themselves upon the anterior face or sides of the crown. These spots often extend to the internal face of the

enamel, which, however, in most cases, preserves its lustre. Although in general it takes its origin in the rudimentary tissues, yet this alteration may depend upon too great pressure, or upon the great nearness of dental caries; but, in this case, the tooth is not painful, and its alteration ceases mostly with the destruction of the mechanical cause which produced it.

In another kind of decomposition of enamel, we observe the spots to be of an unpolished white, circumscribed, situated ordinarily on the anterior face of the incisors, and very often near the external part of the neck of the inferior molars. Their color becomes yellow by degrees, and disappears with the lustre of the enamel. This possesses a delicate and brittle texture, which causes it to break into small particles, even to its complete destruction, with the least effort. In this case, the teeth are sensible to cold, to heat, and even to the contact with all strange bodies, and become easily encrusted with buccal acid and tartar. As a habitual prelude of caries, this variety of decomposition affects, in preference, persons of a bilious temperament, convalescing from long diseases, in the course of which they have been frequently salivated. If the affection is light, it heals itself often, by the re-establishment of health, assisted, by all means, with habitual cleanliness.

Discoloration of Enamel.

The teeth offer, under the relation of color, certain differences, which constantly coincide with certain general dispositions of individuals, and often, in this respect, furnish important indications. In general, those of first dentition are of a brilliant milk-white; but among adults the shading of color is very variable; we can, however, reduce them to three principal ones. The unpolished white, approaching to yellow, is found principally among subjects enjoying excellent health; they are ordinarily short, in regard to the stature and strength of the individual. Grey-white denotes, on the contrary, a quality less advantageous.

But, of all the colors of the teeth, the least to be desired is blue-white. They are most ordinarily found among young subjects, (especially young girls,) who are affected with diseases

of the chest, principally those that characterise a development of tubercles upon the lungs; subjects that are vulgarly designated by the name of *consumptive*, and who very rarely possess the advantage of preserving their teeth perfect until the end of their lives. This observation has already been made by Blumenbach and Camper; it follows that the azure tint of the teeth will be the manifest symptom of an alteration existing in the ivory of the teeth. Thus it is, in a great number of chlorotics, the teeth take, after the first period of the disease, the color of brick-yellow, which we always regard as the sign of a fatal termination.*

One perceives, then, how all the relative details to the diversity of the tint of the teeth, and to the appreciation of causes after diseases which might have occasioned it, ought to be of importance to the attentive physician, since their simple inspection affords not only a knowledge of their length, but of the constitution of the individual, and of the different diseases he might either have been affected with, or more particularly exposed to.

How, can it be asked, do these differences of color and quality belong to the teeth? This question has not, certainly, until now, obtained the attention that it merits. All that which is believed to be known, and which contents us, is that these differences belong to the chemical composition of their organic substance. Thus, those whose tissue is of deep yellow, and scarcely impressible, might have a superabundance of calcareous salts; those, on the contrary, which are distinguished by their whiteness and sensibility, and which are tender and delicate, might owe these qualities to a predominance of animal matter. These two fundamental differences, whose existence is little contested, are met in two kinds of constitution and temperament, altogether opposite, and evidently belong to the general dispositions of the economy.

* Begin has also reported to the Academy of Medicine, that, in this case, the teeth present sometimes a bluish color, which not only occupies their surface, but even penetrates into the interior of the dental tissue; this coloring became so deep that the boys of the amphitheatre complained of not being able to sell them.

From thence it is perceived how it is difficult in admitting that the discoloration of the teeth, in a great number of cases, may be the result of a pathological state, to trace to its relative exact therapeutic rules. This discoloration, being ordinarily effected under the influence of a general change in the organism, our course should be always subordinate to the treatment of this change. Thus, when in the course of a disease, the teeth have taken an unusual color, we see them take their natural color when the affection ceases, especially when it is of short duration. But in the mean time, this change or return of color seldom takes place where the disease is long, or after the age of forty, or even of thirty-five years, a period when the vitality of the teeth has necessarily lost a great part of its reactionary force, All attempt, in this case, will be, as we have already said it, chance with an imprudent or inexperienced dentist.

We except, by all means, from this anormal coloration, which belongs to a general state of economy, certain greyish or yellowish spots, which form often near the neck of the teeth, without having anything in common with tartar. These spots have no thickness upon the enamel, and ought to be observed.

Consumption of the Roots.

This affection is rarely *idiopathic* ; for it is nearly always occasioned by an alteration of the envelopes of the roots, as of the periosteum, of the alveolar membrane, or surrounding soft parts, which, by their inflammation, and consequent suppuration, cease to adhere to the teeth, which they reduce to the state of a foreign body, whose destruction becomes inevitable. This disease is developed in various conditions of age and health ; sometimes among subjects from the age of forty to fifty years ; among those, principally, who, at that age, experience a sudden change of constitution ; sometimes, on the contrary, among young men ; but now and then among females newly brought to bed.

This disease, which is not confined to a single tooth, but extends sometimes to many, and even to the alveolar border of both jaws, although local in its origin, can, as we perceive,

acquire a troublesome importance. It is natural to think that the use of topical tonics, even a few astringents, in modifying the vitality of diseased tissues, ought, after the inflammatory period, oppose the loosening of the tooth and prevent its consumption, or at least the atrophy of its root. Experience unfortunately does not always accord with this indication of the theory. We are sometimes obliged to abate a disease, by applying a button of caustic upon the principal seat of the disease; and if this means does not succeed, it is necessary to extract the tooth around which there is the most inflammation. This sacrifice ought even to extend to many, if the disease has reached the whole of one jaw or different points of both; and this had better be done too soon than too late; the consequences, however, must be weighed well first.

Dental Caries and its Varieties.

We designate under the name of *caries*, that change so common to the teeth, which consists in *a gradual destruction of a part or of the whole of their substance.*

Is this change of nature absolutely identical with that which affects the bones in general? It was believed so a long time, and this opinion was inferred by the analogy which seems to exist between the osseous tissue and that of the teeth. But the opinion at the present time is, as we have already advanced and demonstrated at the commencement of this work, that the teeth constitute in the economy a kind of substance, a part of whose intimate composition is certainly far from being exactly that of bone; for the enamel which forms, as every one knows, the most exterior layer, contains neither fibrine nor albumen: water alone is found there, in combination with phosphate and carbonate of chalk; and if some animal parts enter into the tissue of the subjacent layers, they are so mingled with these two salts that they do not absolutely perform any contractility, and are endowed only with a feeble irritability.

The absence of nerves and visible vessels in the ivory, the kind independent of the teeth, although they partake directly of life, do not permit us to establish between them and the bones

any exact relation, it is natural to suppose that there might be between the morbid affection which is the object of this article, and the caries of the bones, as much difference as exists between the tissue of these two parts.* This supposition admitted, it is no less just to avow *that these two changes have, for a common characteristic a softening and decomposing of the earthy parts which enter into the substance of the organs that they affect.*

There are few diseases which, since the time of Hippocrates, may become the object of more researches, and the subject of more writings, than dental caries; and, however, in spite of these enterprising works, mostly made by celebrated physicians, able observers, it is still difficult to form an exact idea of the pathological phenomena which constitutes it. This difficulty happens principally from this, that authors have confounded, under the common name of *caries*, diseases that are important to be distinguished, because there exists between them remarkable shades, under the relation of causes, of the progress, of the final results, and, consequently, under that of the treatment, which forms here the essential point.

Of these diseases, designated under the general name of *caries*, some are entirely produced by local agents, and consist in the chemical destruction of the dental substance; destruction which is made from without inwardly, and of which we will speak hereafter; others are caused by a disease of the pulp, or a primitive defect of the ivory, and develop themselves spontaneously from within outwardly. This last kind we designate more particularly under the name of caries.

* At the same time when we give the passage for print, we take notice of the memoir that Nasmyth, member of the College of Surgeons at London, has submitted to the institute, and in which he says that the teeth offer not a *fibrous* disposition, as it has been believed until the present, but *porous* and *cellular*. This fact, which appears very important at first, destroys completely the difference which exists between the bones and the teeth. It shows only that they have a common character besides to add to those which reside in the presence of calcareous salts as a base for one another. But the identity of their mode of development does not seem sufficient to establish the fact that they are upon the same line in that respect. (See the exact account of the meeting of the Institute of December 5th, 1842.)

Whatever may be the import of the denomination, the disease is so common, that few persons, even in the best of health, are exempt from it. It attacks indiscriminately children, young men, adults, and even spares not old men. It is natural to suppose that organs which, during the time of their formation, have been submitted to the influence of general causes, which have acted upon the whole constitution of the individual, ought necessarily to undergo, at a later time, the effects of them.

That consequence, that we have already treated of, in speaking of the diseases of the follicles, and to which the most simple observation conducts, we explain, because we daily see it in individuals born full of vigor, whose health has never been impaired, and who, in the mean time, have had, from their youth, very bad teeth, whilst others, of a weak and languid constitution, have very beautiful and strong ones. It would be, then, as irrational to endeavor to trace all the causes of caries to the time of the formation of the teeth, as to disavow all the influence that the diseases of the first age might exert upon the development of caries with which the teeth are attacked even at an advanced period of life.

Caries being the most frequent disease of the teeth, a disease whose treatment and results form the most important part of our calling, we should study it with great care. In order to omit nothing useful, let us examine it successively, under the relation of its causes, of its symptoms and its course, of its seat, its diagnosis, its prognosis, and its treatment.

First, Causes.—Amongst authors who have studied caries, in explaining the causes of this singular and often exclusive disease in its course, some have admitted only internal ones; others, on the contrary, but external ones. But the greatest number, at the present time, believe they result from both, and most generally from simultaneous action. Hunter* thinks that it is hereditary, and regards it as a kind of mortification or necrosis of the dental substance. When we reflect, in effect, upon

* *Natural History of the Teeth and their Diseases.* London, 1771. Translated in Latin, 1773; German, 1780.

the frequency of caries in the members of the same family, we are not far from admitting this disposition. Fox* believes it always is a defect in the primitive formation of the teeth. This opinion is corroborated by this fact, that we have already established, knowing that the disorders of caries are confined often to teeth which formed during the course of a certain period of dentition. It is to this kind of alteration that it is necessary to refer constitutional caries that we meet so often among members of certain families, that have either caused primitive and original disposition, or that they depend upon local or accidental influences.

Caries, we have said, does not escape any age; but habitual observation declares that women and young men are more exposed to them than middle aged and old men. They seem endemic in certain countries, particularly in humid and marshy districts, or neighborhoods bordering on the sea. Holland offers a remarkable example of this.† It is, then, in the influence of general agents, which modify all the organism, that it is necessary to seek for the first causes of caries. It is thus that the teeth, whose texture is weak and soft, which are of a milk-white, of a dull blue, and consequently defective, carry in themselves the sources of their premature destruction. There is in them a number of organic or accidental diseases, as scrofulous affections, tetter, lymphatic gout, severe or chronic inflammations, nervous diseases, too rapid growth, which are as many general causes, under the influence of which caries develops itself.

Although many of the causes that we have shown as capable alone, by their powerful influence, of affecting the composition of the ivory, to involve the teeth, as soon as they are formed, in inevitable ruin, it cannot be denied that, in a great number of

* *The History and Treatment of the Diseases of the Teeth, Gums, &c.* London, 1806.

† "We have two very striking examples of this in France; the inhabitants of the countries of Caux, and those of the environs of Bauvais, in Picardy, have, for the most part, the two central incisors of the superior maxillary decayed; after these the laterals are affected; and thus, in turn, in such a manner, that at the age of thirty years they have lost the greatest part of their teeth." (Rosseau: work quoted.)

cases, they exist only as predisposants, and have effect only by the train of local circumstances, or, to speak plainer, actual ones. Is it not observed, in truth, every day, that caries destroys with promptitude teeth which have scarcely appeared through their alveoli, whilst among other subjects, as unfavorably placed, it commences a long time before manifesting itself, or appears only to occasion accidental influences, perfectly characterised.

Amongst the local causes which produce caries, it is necessary to place those bodies which, being placed in contact with the teeth, are capable of exercising upon them an unfavorable effect, by their temperature or chemical action. The influence of heat upon them is most evident, as we have already observed, in the chapter devoted to hygiene. Likewise, the use of warm drinks, among certain nations, seems to us eminently pernicious, as those in England, Holland, and as we have even observed frequently in Russia, where wealthy and opulent men lose their teeth in early years, whilst their domestics preserve theirs perfect to an advanced age.

Many authors also have thought cold to be one very powerful cause of dental caries. If this assertion is not completely false, it is at least much exaggerated; for the people who occupy the regions of the extreme north, as we say, have the most beautiful teeth. It is not, then, very probable that cold by itself exerts an unfavorable influence, but only the sudden passage from a warm temperature to a great cold, which, destroying the equilibrium in the cohesion of the molecules which compose the teeth, causes in them hasty movements of dilation and obstruction, the more common result of which is caries.

As to the preference which caries has for the two superior incisors instead of the lower ones, all things besides being equal, it is explained, according to our opinion, very naturally, by the position of the first, which renders them more exposed to the action of external bodies. Finally, in the action of prehension of liquids, or, to speak plainer, in the action of drinking, they receive nearly always the impression of the fluids, which the inferior are prevented from, even by the vessels we use.

A great number of bodies cause caries by their chemical action. It is thus that acids act, although it may not be as easy

as it might be thought to explain why this chemical action engenders caries sooner than a simple decomposition of enamel ; which, according to our opinion, is another thing.

An able dentist of our day, Regnard,* it is true, considers caries only as "*a destruction of the teeth by decomposition*," and this decomposition finds only a cause in an acid developing itself, either in the humors of the mouth, or in the alimentary substances which remain around the teeth. "He gives as a support to this assertion three proofs, thus :

"1st. Artificial teeth were fastened by threads of silk. These threads, which surrounded the neighboring teeth, became impregnated with saliva, and covered with alimentary particles, and soon corrupted them ; they became then a cause of caries to the teeth. This is so true, that the limits of the caries proceeding from this cause are traced by the thread itself.

"2d. For sustaining the artificial teeth, metallic caps were made to envelope one or more of the teeth. These constantly served to remove the pain produced by the rapid wearing away of the teeth. These caps were not made with so much precision, that there did not exist any space between them. The fluids of the mouth, the alimentary particles, soon lodged in these spaces ; and if persons who wore these caps were not very careful, these fluids of the mouth, these alimentary particles, decomposed, and became then an active cause of caries to the teeth. I have seen molars whose crowns were entirely destroyed by the action of this cause in the space of six, five and even four months.

"3d. Human teeth and the teeth of the hippopotamus were used for artificial teeth. These teeth being of an organic nature are capable of decomposing in the mouth. Then, if by a badly arranged economy, the persons who wore them preserved them still when they are in a state of decomposition, they decayed the neighboring teeth, which are immediately in contact with them."

Regnard strengthens these different proofs by the following considerations :

"If, now, I devote my attention to the parts of the teeth in

* *Of Dental Caries.* Brochure in 8, Paris, 1838.

which decay commences, I see that they are precisely those where the aliments and fluids of the mouth stop and remain sufficiently long to decompose themselves. It is in the necks of the teeth, in the interstices of these organs, in the anfractuosities of the large molars, in these pointed holes, that we observe sometimes upon the external face of the first and second large inferior molars or upon atrophoid teeth. If we reflect precisely upon the mode of action of caries, we see that they act in the same manner as an acid, that they deprive the tooth of its phosphate of lime, and upon the point where it exerts itself it reduces it to a cartilaginous substance. Let us see if we can find, in the decomposition of the alimentary particles, or buccal humors, an explanation of this phenomena. Now, chemistry teaches us that all vegetable or animal substances, in a state of decomposition, give birth to acidiferous products; to nitric acid, acetic acid, sulphuric acid, etc. all acids which produce the same effect as caries upon the teeth."

To take the action of acids upon the teeth as cause of decay, in as absolute a sense as Regnard, is, according to our opinion, an error, a great error. In adopting it, to the exclusion of all other causes, this practitioner commits the same fault that a surgeon did who, in order to demonstrate that a fall upon the wrist would disjoin the arm, would minutely describe how it acted in the production of luxation, and who, for the correlativeness existing between the cause and effect, would conclude that the arm did not disjoin only in a fall upon the hand.

If we were not prevented by the fear of being too extended upon a pathological point which, all important as it is, is not however the only thing to study, we might make innumerable objections to the theory of Regnard; but we will confine ourselves to the five following, that we shall expose in the order of their importance:

1st. A great number of caries commence in the ivory which is often deeply affected whilst the enamel is entire; a circumstance which has entirely escaped the notice of Doctor Serrurier, who, however, has made a very judicious refutation of the treatise of Regnard.*

* See the *Gazette of the Hospitals of the 20th and 25th of September, and 11th of December, 1838.*

2d. Many teeth, principally the last large molars, come from their alveoli deeply decayed, without having consequently been submitted to the action of any kind of acid.

3d. If it was always and solely an acid which affected the teeth, this action would be general; it would not have but *one point* of decay; the *whole* of the dental system would be certainly decayed.

4th. It is against the evidence of facts that Regnard declares that the use of cider, among persons who inhabit Normandy and Picardy, accounts for the frequency of caries; for, Rosseau remarks justly, that the inhabitants of these two provinces *who occupy healthy* places, "have most generally the most beautiful and healthy teeth,"* contrary to that which befalls those who occupy low places, that is to say humid ones.

5th. Finally the saliva and buccal humors are not as frequently acid as Regnard thought; we have often found alkalies among many persons who had their teeth deeply decayed. Our researches, in this respect, accord perfectly with the opinion of Doctor Donni, who expresses himself thus:

†"The alkalinity of the saliva has been avowed long since; but it has been proven only in these latter years, particularly by the experiments of Tiedman and Gmelin."

Donni is not satisfied even with proving the alkalinity of the saliva, he endeavors also to explain it in these terms; ancient and modern authors have said nothing of the part that relates to the alkaline principle of the saliva. Beyond the usages that is generally attributed to it, it seems, according to my researches, to neutralize the excess of the acid of the gastric juice. This is supported, by most experimenters; 1st, upon the neutral state of the gastric fluid; 2d, upon the impossibility that this effect cannot produce the salts and saliva found in contact with the acid of the gastric fluid; 3d, upon the nature of the salts, contained in the gastric fluid, a great part of whose basis is salts."

Whatever may be the opinion of Regnard, we do not at least acknowledge that the presence of the acidity of the saliva, upon a point of the enamelled substance, might be a cause of decay;

* Work quoted, page 225. † Work quoted.

but then we admit that the person is under the influence of some derangement of the digestive organs, as the author that we have precedingly named establishes so clearly in this remark: "This acidity of the saliva coincides the most frequently with a primitive or secondary state of irritation or inflammation of the stomach, and can serve to establish the differential diagnosis of some gastric affections." To prove this acidity it is only necessary to place upon the tongue a piece of blue turnsole paper: if the paper becomes red, we can predict that the subject is under the influence of some disease. We have also remarked that this acidity coincides often with a thready, thick or glutinous state of the saliva.

The use of certain medicaments, as of mercury, gold, mineral waters, acting equally upon the teeth of their chemical properties, can also be, not only the predisposing, but direct cause of caries. Blows, falls, commotions, and counter blows cause vicious conformation and too great nearness of the teeth, &c.

We might add to this series, a crowd of other causes that authors have mentioned, but they would be too long and superfluous to enumerate here. And how could we explain, in this multiplication of causes of decay, the diversity of effects which produce this kind of dissolution of the teeth, and the variety of aspects under which it presents itself when we consider it, either under the relation of the color and form of the spot which announces its existence, or under that of the place that it occupies, or, finally under that of the rapidity or slowness with which it proceeds in its course?

2d. *Symptoms and Course.*—Caries, according to our knowledge, as we have already said, proceeds frequently from the interior to the exterior. Smote in its vitality, either by an act of nature that cannot be explained, and to which the pulp is not always a stranger, or because the delicateness of its tissue was not able to resist the agents with which the teeth are constantly brought in contact, the ivory becomes the seat of a change which affects at the same time its color and the force of cohesion which unites its particles. A yellow or brown spot manifests itself near the enamel, which it invades by degrees until it extends upon the surface of the crown. This envelope loses in

this respect its transparence, a natural consequence of the separation of the elements which constitute it. Whilst the internal layer of ivory which unites the enamel with the subjacent layers is not destroyed, the spot preserves the color and even shining aspect which belongs to the teeth ; but it loses this brilliancy as soon as the connection is severed which binds the ivory and enamel together.

As there are a great number of external agents which have the power of destroying the cohesion of the elements of the enamel in its most superficial layers, without effecting its deepest layers, often the tooth loses its transparence upon the point attacked, without losing any of its whiteness. The evil does not extend ; the decay is arrested there ; often it gives no other sign of its existence than a slight depression resulting from the disengregating of the elements of this envelope, an effect which mastication produces sooner or later ; it is this that authors have called *dry or stationary decay*. It is rare, however, that this depression is not succeeded by a yellow spot ; for nearly always the salivary fluids deposit a sediment there which alters the color of its subjacent layer. Besides the contact of the air suffices to change the whiteness of the crown deprived of its enamel.

Gradually the tissue of the tooth softens in the place where the yellow spot manifests itself. It forms there a cavity which, increasing in consequence of the progress of its destruction, reduces the enamel to the most superficial of its external layers, so that this substance, being deprived of support, breaks and discloses decay. This cavity thus formed, increases gradually in the interior, representing a cone whose base is at the surface, and whose diameter diminishes in proportion as its depth diminishes.

The course of this first period of the decay is ordinarily slow, and often the person who is affected is warned only by vague sensations, by obscure pains and the bluish tint of the tooth, which, to a practised eye, is a certain sign of the existence of decay. The opening once formed in the enamel, continues gradually to enlarge. If, however, it does not increase, it is because the force of the destructive agent has ceased to act upon the opening, and is confined entirely to the internal layers of the

ivory. It forms there, with the assistance of atmospheric air and other destructive agents, a large and deep cavern which presents exteriorly but a small opening; the enamel may be easily broken, and we discover as in another case, the extent of the ravages in the interior of the tooth. Authors have called this *humid caries*.

The progress of decay is, in general, more rapid among young subjects and among lymphatic individuals; pregnancy appears also to have a great influence upon its course. But it is principally afterwards that it appears externally, that its progress is sensible, as we will now show. Its cavity is entirely filled with a soft, brown, yellow or black matter, of a fetid odor, that the instrument can easily divide and detach in successive layers, which become denser as the healthy parts are approached. This matter, which, according to Regnard, acts as an acid, assists powerfully by itself to extend the evil; it constitutes one of the most active causes for propagating the decay.

When the caries has penetrated to the interior of the dental cavity, the pulp finds itself in contact with external influences and becomes sensible to heat and cold and the impressions of hard bodies. The tooth is then the seat of obstinate pains which sometimes are spontaneously disclosed, sometimes provoked by the slightest exterior causes. These pains manifest themselves generally by access, and are accompanied by all the symptoms of a local congestion, and to which is added many times different nervous complaints. Throbbings are felt in the tooth and often in the temporal arteries, and an abundant salivation afterwards follows. This paroxysm, which is more or less long, is repeated at different intervals, and are often only the prelude of inflammation and suppuration of the pulp; from thence is produced more or less serious inflammatory fluxions and different disorders.

If, in this state, one removes the tooth, its cavity is found filled with a greenish and very fetid matter. Its vessels trace across the ivory of the root a black color; the dental cord is very large and filled with blood. Thus deprived of the organ of its vitality, the ivory continues to be destroyed; the enamel alone remains, becoming broken off by fragments, and finally the root

alone remains, which ceases generally to be painful until extraction, displaying itself in being extracted. All these ravages have place in the interior of the tooth, without they are called by some other symptom, but we do not observe their existence before the rupture of the layer of the enamel, if, as the principle of evil, it is not accompanied by a pain at first obtuse and like a dullness, but finally becomes very acute. Caries of this kind, although less common, are nevertheless met with very often.

Caries presents, in its course and in its symptoms, a number of modifications, which it will be difficult to describe; which, however, some authors have attempted to reduce to species. Among others, Duval admits seven, that he calls *calcareous*, *decorticating*, *perforated*, *carbonated*, *disruptive*, *stationary* and *erosive decay*. Maury has punctually followed this division. We do not follow it for two reasons: the first is, the characters which serve as a base for them are very variable, and altogether arbitrary, and that many do not really belong to caries, but to defects altogether different, with which Duval has confused them. The second motive is, that in multiplying divisions and subdivisions, in the study of specialities, it seems as if we wish to withdraw from the organs upon which they exercise the general laws of common life, which, ordinarily, ought to suffice to explain all. The adoption of the division of Duval causes us to regard caries as the type of all the diseases of the teeth, and of their changes that we have already described, under the names of *discoloration and decomposition*, and of *erosion*, and which we shall soon examine under those of the *wearing away* and even of *fracture*. This will approach least to error.

If it is necessary to adopt a division, to facilitate the study of the disease which we are now treating of, we do not hesitate to receive that which we have formerly proposed, according to which there are two fundamental distinctions, under the names of *dry* or *stationary caries* and *humid* or *progressive*. If it limits too much the shades of caries, it has at least this advantage, that, in a practical point of view, it unites the most important characters of the disease, that which, consequently, renders it more just, and better founded than the most of the numerous distinc-

tions that the desire of novelty and singularity has sought, in our day, to establish.

3d. *Seat*.—It can be said, in general, that there is no tooth the seat of decay, for all are subject to it; some, however, more so than others; the molars are principally affected. The incisors and canines of the upper jaw are more frequently affected with it than those of the lower jaw; it shows itself nearly always upon the sides of the anterior teeth; less frequently upon their external face; more rarely still upon their lingual or internal face, and scarcely ever upon their cutting edge.

The large molars are frequently decayed upon their sides which touch each other, but more commonly it appears in the midst of the depressions of their triturating faces. If the teeth of this class are more subject to decay, it is because they present the most extended surface, and because the layer of enamel which covers their triturating surface is often weak and badly crystallized between the tubercles and sinuosities of the crown. It is necessary to add to these reasons the power of the mechanical forces which have the greatest resistance to overcome in the act of mastication, and the particles of food which remain in their depressions. The lateral sides of the small molars are at least as subject to decay as their triturating borders. Those of the lower jaw, but one point clearly marked, the same is the case with the incisors and canines.

Finally, the teeth do not always commence to decay upon one point. We often find caries between all the eminences of the molars, upon the two sides of the anterior teeth, and sometimes even upon different parts of the same side. All the parts above the gum, being more exposed to the action of exterior causes, can consequently be affected by it.

The first signs of decay manifest themselves sometimes at the place where the enamel terminates, that is to say, the neck of the tooth; but its progress is generally terminated here, and leaves the root untouched. There are, nevertheless, examples of the root being affected; it is, however, very rare that the disease penetrates to their extremity; they are changed only in some parts of their extent; still it is necessary to avoid considering the different affections of the root as belonging to caries, for

very often, as we have already said, they are the results of morbid effects of the periosteum, which cause disorders more or less serious.

There is no practitioner who has not remarked that the corresponding teeth in the same jaw are very often attacked with caries at the same time, or at very near intervals. This co-relativeness is so evident to every one, that authors have sought to explain it. Some confine themselves merely to saying, that the corresponding teeth in the same jaw, being of an identical texture, become decayed at the same time; others, that the distribution of nerves being the same in them, they necessarily are equally susceptible, and yield at the same time to the active causes capable of producing unfavorable effects upon the dental system.

Neither the one or the other of these two explanations, given for the purpose of contenting superficial minds, are admissible. In effect, the texture of all the teeth, except in regard to their quantity of matter, being identical, nothing, in this respect, can explain why the corresponding teeth in the same jaw are decayed at the same time. The distribution of the nerves can explain this phenomenon, if each dental nerve comes directly from the sensitive system to the tooth that it is required to give life to; but, as we know, each of these diverse fibres comes from a common trunk, which communicates to all an identical sensibility, we can deduce nothing from this.

The following, according to our opinion, is the only explanation which seems rational: the teeth which correspond in each jaw, being generally submitted to the same phenomena of formation, development and appearance, ought, then, to possess an equal degree of vitality and sensibility, and consequently are compelled to yield at the same time to the action of agents which might put in play the predisposing diseases with which they are affected. This opinion confirms, besides, two assertions that we have already put forth and developed; to wit, that a great number of the diseases of the teeth date their formation from the follicles, and that caries is very often the result of interior causes.

Finally, the wisdom teeth are sometime decayed when they

are cut, especially when their eruption is retarded ; this fact will also assist to prove that which we formerly endeavored to do, namely, that the acids that the aliments contain, or which form accidentally in the mouth, are not the principal causes of caries. The milk teeth are very often affected, generally the molars, and particularly the inferiors, whose roots destroy themselves gradually, even to the crown. These are often forced to be extracted without the teeth of replacement, which are ordinarily separated from them by a partition, undergoing any change.

But that which is still more remarkable, and which, to our great astonishment, we do not find described in any work, is, that the caries of the milk teeth cause very rarely those sharp pains which accompany so frequently that of second dentition. For do we not see small children carried to a dentist, on account of true dental pain? When we reflect, we see that it might necessarily be thus, because these teeth, condemned to fall, are separated, at an early period, from the centres in the midst of which they derive the materials necessary to their life and sensibility. The practical consequence which flows from this fact is this, when a child is brought to us for the purpose of preventing pain coming from the milk teeth, instead of treating the decay, we should examine if some fragments of roots do not tumefy the gums, or even perforate the alveoli, &c.; and we will be assured that that pain is produced by some tooth ready to be cut, or by another cause.

4th. *Diagnostic.*—It is not always easy to discover caries, when it has not manifested itself by any external sign. The sensibility and pain, which often causes us to suspect them, do not always exist; we have even seen persons lose a part or all of their teeth, without experiencing the least pain. Sometimes caries manifests itself by sympathetic pains, as chronic ophthalmies, otites, stubborn coryzas, etc., which cease, as by enchantment, after the extraction of certain diseased teeth.

Then the pain and sensibility experienced by heat and cold, and by the contact of hard bodies, are not certain signs of caries, since they could be completely in fault. The inspection of the teeth remains to prove it, which, in general conducts to a more certain diagnostic ; we say, in general, for in some cases

we are obliged to resort to another mode of examination, which consists in percurating, successively, the teeth, one after another, by means of some hard body, until, by the pain or sensibility, we can determine the right one.

5th. *Prognosis*.—The prognosis of caries varies according to the extent, the seat, the progress and nature of the affection, and often according to the constitution, the age of the subject, and the diseases to which he has been exposed. Decay which attacks lymphatic individuals, whose parents had lost their teeth in early years, those which attack at the same time a great number of teeth, are in general a sad omen; for they are always followed by a total destruction of the dental system. That which is of a yellow color, ordinarily progresses more rapidly than that which is black. When its seat is at the neck, it is always more dangerous, because the destruction is very near the dental cavity, and necessarily reaches the pulp sooner. Again, this kind of caries is sometimes concealed, and we are not consulted in relation to it, until it has made great progress.

Finally, experience attests that caries which affects persons who have a compact denture is always more dangerous. If we wish to enlarge this volume, and to deprive it of the practical character that we had intended giving to it, we might seek why the too great nearness of the teeth is harmful, and becomes, in a great number of cases, a cause of caries and a means of increasing the disease. But it suffices us here to prove the fact, and to remark that a modern author* has perceived himself able to explain it, in saying that caries proceeding from the obstacle that the nearness of the teeth offered to the free course of the fluids which circulate in the enamel; but this is a hypothesis too gratuitous, and which has not the appearance of reasonableness. By what means, then, can we remedy the inconveniences of a too compact denture? By separating, with a file, the edges which touch. Now, a loss of substance might oppose still more the free course of the fluids of the enamel. We will return again to this subject.

6th. *Treatment*.—If, from pathological considerations which

* DELABARRE: work quoted.

precede, we pass to the therapeutical question, we must acknowledge that, in the treatment of caries, we ought to have in view but three distinct objects: to preserve the teeth healthy and from all disease; to seek to remedy their disorders by endeavoring to arrest their progress; to destroy or alleviate their pains.

To accomplish the first, we must remove all the causes, that, directly or indirectly, cause or develop caries; and we can arrive at this result only by following, with punctuality and perseverance, the *hygienic* precaution and cleanly habits, to the development and explanation of which we have devoted a chapter. If the tooth is badly decayed, it is necessary to extract it, or if it is possible to plug it, or if the disease is light, to isolate the affected part by the use of the file; for it is an incontestable fact, that caries can be propagated by simple contact, whatever may be the explanation of the means we have sought to give of this propagation.

The natural deduction, from what we have previously said, is to separate, at an early period, the decayed teeth that touch, and for a still stronger reason those which thus change rest one upon the other, generally, when this vicious disposition is carried too far, others multiply. Many practitioners, struck, without doubt, with the insufficiency of the explanation given of the propagation of caries from one tooth to another, have denied the utility of this operation, because some persons have preserved their teeth free from decay, notwithstanding their close proximity. This reason is specious, for it rests upon exceptions, which proves nothing in the presence of the plurality of cases which attest this law of communication.

Let us, then, conclude, that when the decay has made but little progress, and affects their lateral surfaces, it is necessary to hasten to remove, by means of the file the decayed portion. But when it has been carried so far that it occupies the external or internal side of the crown, when it will be difficult to use the file, it is necessary to plug the tooth, or, to speak more concisely, to fill it with leaves of gold, silver or platina, or some other substance capable of exactly filling the cavity, in such a manner as to completely exclude all foreign substances.

This operation succeeds in a great number of cases, especially if the dental pulp has not been exposed. But if it has been, it is necessary to proceed with prudence to those operations, the results of which might be injurious; for it is easy to perceive that if the tooth be the seat of a sharp pain or acute inflammation, the presence of foreign bodies employed to fill the diseased cavity, would only augment the one and favor the other. Some practitioners abstain from plugging teeth in pregnant women, under the pretext that they have seen accidents follow the most simple operations, especially among women who have a disposition to dental fluxions; they prefer, when pregnancy is much advanced, to wait until after the birth of the child. We do not approve of this plan; for, during pregnancy, the caries has at the same time destroyed the tooth altogether, and causes us to regret a temporization that, according to us, nothing will justify.

According to our opinion, even in the exceptionable conditions that we have mentioned, it is necessary to remove the caries promptly from the action of the air, and the contact of alimentary particles; for among these persons it progresses with fearful rapidity, and communicates easily; to temporize it would be an imprudence which has the double inconvenience of favoring the progress of the decay, and of rendering it difficult or impossible to keep the mouth clean.

Some dentists, struck with the inconveniences of plugging teeth affected with humid caries, have proposed different substances to dry these caries, and to render the tooth in a fit state for natural remedies, by the hardness that these substances have appeared susceptible of acquiring. These pastes are composed of different salts and of some sharp narcotic powders, to which they have given the name of obliteric cement, or something analogous to it. As these pastes, notwithstanding the hardness that they can acquire, do not dispense with plugging, we believe them to have been advised rather by the desire of attracting public attention, eager for novelty, than by the wish to disclose a therapeutical indication rationally established. We will speak more of it in future.

Dental caries, we have said, is ordinarily accompanied by pain, which constitutes a particular indication for treating this

disease. When these pains have acquired an extreme intensity, and have become permanent, without doubt the tooth should be extracted, which is the seat of the disease, as this will relieve the pain. But, in many cases, the pain is slight, and manifests itself at distant intervals, and only as the result of accidental circumstances, whence it is easy to recognize the cause, and to destroy or moderate the effects. It would then, at least, be imprudent to sacrifice an organ scarcely affected, which might in a moment have its pain removed, and still render important services.

As decay is the cause of the extraction of a great number of teeth, perhaps it is this more than any thing else which induces us to blame the readiness with which a number of persons, for a slight pain, wish a tooth extracted, and the cold indifference with which certain dentists accept their proposition. Let any one reflect an instant, either upon the mutual relation which exists between the teeth and the bony cavities which receive them, or the reciprocal support that they furnish one another, and he will be fully convinced that their great solidity depends in part upon the preservation of them all.

In extracting a tooth, we shall see, in the description of operative mechanism, what precautions one should take in performing this operation, for he is liable to fracture more or less the bony partition which forms the cavity destined to receive it. This fracture causes a weak point in the maxillary arch; the necessary consequence is then, by the collision of the jaws in the act of mastication, that all the teeth, pressing towards this point where it finds a defective resistance, are liable to lose that firmness which they enjoy in their natural state. Without doubt we see every day persons who have very solid teeth, although one or more teeth may be wanting; but these exceptions do not destroy the physiological reason by which we could prove that the teeth themselves furnish reciprocal aid.

Being convinced of this fact, the dentist ought then, in numerous instances, to seek to calm the pain before resorting to the extremity of extracting. And certainly, if the possibility of arriving at this result be proportioned to the multiplicity of the means proposed to this effect, the destruction of the pain will be the simplest and easiest thing in the world; for there is no point

in medicine, however fruitful, upon which the genius of therapeutics, might not be exercised. Many persons, guided unfortunately more by the desire of gain than by the love of science and good of mankind, make sport of deceiving the credulity of the public and their taste for the marvellous, by giving, as certain specifics, either efficacious means, but which, reduced to their just worth, have but a circumstantial action, or other means absolutely useless, but whose imaginary action, depends upon certain imposing or mysterious demonstrations which accompanies their employ.

Truly, as a modern author remarks, these are the fallacious promises which have sharpened against us the arms of the satirist, whose darts are not only too just in numerous instances, but which prejudice many persons unfavorably with regard to our art, thereby preventing them from counselling us, which, had they have done in time, might have preserved their teeth but slightly altered, and prevented them from sustaining so many painful operations to which improvidence reduces but too often to our calling.

"It is in vain that experience has proven a thousand times the inefficacy of most of the sovereign remedies to cure the pain dental caries occasion, still they are sought with eagerness, and received with an admiration which, without legitimacy, shows perfectly at least the net drawn on all sides for the credulous public. Happily the vogue of this remedy is as ephemeral as it is great; but so great is the fear of pain, that persons are mistaken, and a number belonging to the enlightened classes of society have recourse to their use. These remedies, which have appeared with so much brilliancy at different epochs, have finished their career by being unmasked."

To the eyes of every enlightened person, the means employed for calming pain, caused by caries, ought to differ as much as this disease varies in its intensity, its cause and its nature. Whatever may be these means, their mode of action is reduced; first, to calm the inflammation of which the dental pulp or the auxiliaries of the decayed tooth might be momentarily the seat; secondly, to excite another part more or less distant from the diseased tooth, and to absorb thus the pain in this last; thirdly,

to suppress locally or generally or even to destroy the sensibility of the tooth ; fourthly, to withdraw the cavity of the caries from the action of the air, of alimentary particles and from all matter more or less irritating, with which it may come in contact. There is no substance having any efficacy, whatever may be the prestige or secret of its use, even emuletes on and remedies of commerce, which does not belong to one of the four classes of which we shall now speak. We will pass them successively in review, and reduce them all to their just worth.

The means which belong to the first are the antiphlogistic. These are employed, although their name indicates this, when the pain is developed with inflammatory characters, as for example, when it appears under the influence of a sudden change of temperature ; when the gum surrounding the decayed tooth is rough and tumefied ; when the neighboring parts, which seem to occupy all the side of the jaw from the diseased tooth, are swollen, and when the vital reaction is made known by an elevation of the pulse, a redness of the face and a beating of the temporal arteries.

The most efficacious of these means are sanguine evacuations, general or local. The first is obtained by opening a vein in the arm or foot ; the second, by applying some leeches behind the ears or below the angle of the jaw, and even upon the tumefied gums. This last means, although it remedies the disease, is more simple and less difficult to employ than is commonly believed ; it consists in enclosing a leech in a glass tube, and presenting its buccal extremity to the gum that it may deprive it of its superfluous blood ; this can be accomplished still better by scarifying it first with a small lancet. These sanguine evacuations are commonly followed by diet, drinks, softening gargles, fumigations, cataplasms, and applying upon the gum a warm fig, etc.

In the second class are arranged, under the name of derivatives or revulsives, all the means capable of producing reactions, pediluvia and sinapisms, applications of cold water to the head and upper part of the neck, and of blisters and cups behind the ear.

Finally, sudden moral feelings, strong impressions, which

sometimes instantly calm the most acute dental pains, among nervous persons, are only derivatives which, affecting the brain immediately, convey the painful sensation from the cavity of the tooth. We can then attribute to fear the cessation of pain which so often takes place, as by enchantment, even when the patient arrives at the door of the dentist, or, in other cases, at the sight alone of the instruments which are employed in the extraction of a tooth. Sometimes an energetical purgative has produced the same result.

In the third class are placed the innumerable *odontalgics*, or means which are employed for the purpose of calming or even of immediately destroying dental pain. They act in three ways: narcotics, which moderate active sensibility; they comprise all preparations in which opium, camphor, henbane and belladonna enter; tinctures and natural oils, which excite the membrane which lines the dental cavity; finally, concentrating acids and cauteries, which cauterize either the dental nerve, or the decayed part.

Opium is ordinarily employed in the state of an extract, and in doses of one half a grain, which is dropped upon cotton, and then placed in the cavity of the tooth; the tinctures are frequently of myrrh and spoonwort; and the essential oils those of mint, cloves, cinnamon and cajeput; we might add a number of other preparations, as, for example, a plant known under the vulgar name of catsherb, (*nepeta cataria* de Linne,) whose use Dr. Guastamacchia recommends, and which have nearly the same chance of success. Their mode of employment is similar to that of the acids, with this difference, the moist cotton should be covered with a piece that is dry, in order to preserve the neighboring parts from the irritating action of these substances, which is either hydro-chloric acid or tincture of cantharides and creosote, &c.

With regard to the actual cautery, it is the most certain means that can be used; it joins to the promptness of its action an almost uniformly happy result. This operation, advised by Ambrose Paré, limits the extent of the decay, by disorganizing the vascular nervous pulp, and reducing it to an inert state. It is to be regretted that this treatment has some incon-

veniences, which often counterbalance the instantaneousness of its action: thus, for example, if we wish to preserve a part of the decayed tooth, it is sometimes injurious, because, in removing the cautery from the crown of the tooth, the caloric will, in certain cases, crack the enamel, and render the bad effects still greater; finally, it is not very easy to limit this action; inflammation follows, which extends to neighboring parts, and gives rise to fluxions and abscesses in the alveolus.

From this physiological mode of the action of the various agents admitted, or made known by charlatans for allaying pain arising from caries or other affections, the result evidently is, that there is no true specific for the relief of this pain. Thus, some practitioners, wishing to find a remedy that would be applicable to most cases, have proposed preparations which consist of the union of substances the efficacy of which was least doubtful. It was this idea which induced Dr. Handel, of Metz, to prepare the following preparation, whose action might be very advantageous:

R Opium,	3 ss,
Ol. henbane,	3 i,
Ex. belladonna,	gr. 10,
Camphor,	gr. 10,
Ol. cajeput,	3 i,
Tr. cantharidei,	3 i. Misc.

This opiate and similar ones seem convenient, as Maury with reason remarks, when the odontalgia caused by the caries has its seat in the superior jaw, because we can apply them in an immediate manner; which might not be as easy if we employed medicinal liquids. We can make for the same purpose a paste consisting of a concentrated decoction of roots of sweet fennel, ginger, frankincense, heads of cloves and of cinnamon, reduced to the necessary consistence. We notice that this means has in view an irritation sufficiently great to inflame the dental pulp, and under this influence it ceases to be sensitive, by the destruction of its vitality.

Finally, in order to complete the list of means prescribed to arrest caries, or the evils attendant upon them, we should mention camphor, which a learned chemist has recently prescribed

as an infallible remedy.* The *therapeutical* indications upon which this is founded, is the destruction of the worm which, according to some, accompanies the disease. This opinion is not new, as we perceive; for it is the basis of all the boastings of the charlatans, who seek to deceive the blind credulity of the people. We should, then, refuse to give credence to this, although, by means of microscopic examinations, made without prejudice, we have sought to enlighten ourselves; and we see, in the camphor, only a substance which adds to its anti-spasmodic qualities the *odontalgic* action which it exercises sometimes.

Concerning all of these means, and an infinite number of others, which ignorance and cupidity daily divulge to the marvellous, if they succeed sometimes, they fail oftener, and frequently the patient is relieved of his sufferings only by fluxions, which cause the suppuration and destruction of the dental pulp. When the caries has made extensive progress, the extraction of the tooth can only free the patient from the lacerating pains that habitually accompanies it. Before adopting this final operation, many authors have proposed other means.

One of the most specious is the excision and extraction of the dental ganglion; for this operation a small drill is used, which is placed in the cavity of the fang, and, giving the drill a few rotary motions, it is withdrawn with the dental pulp attached.

Delmond has described, with care and much detail, this operation.† If we have not at hand the proper instrument for this operation, a substitute might be made of iron or platina wire, resembling a single *facies*, and which can be readily introduced into the canal of the tooth. By giving the wire a shape resembling a cork-screw, we can with it readily withdraw the dental pulp.

When this method, which cannot be employed excepting for the six anterior teeth, on account of a number of difficulties which we might mention, and when the crown is not suffi-

* M. Raspail, Letters on the Medical Virtues of Camphor, in the Hospital Gazette, November and December numbers, 1838.

† A Treatise upon a New Method of Destroying the Dental Pulp. Paris, 1824.

ciently injured for us to decide to sacrifice the tooth, some practitioners prefer to trepan it in the direction of the root, with a small burr drill. The dental cavity being thus exposed, they destroy the nerve, and plug it, after having kept it filled with cotton several days, if the cavity continues healthy. In speaking of Oudet, as a practitioner who frequently adopts this method, we do not pretend to say that he was the originator of it; for we find, in the *Medical Review*, a detailed description, given by Fattori. "This method," say the compilers of the article, "is entirely based upon this principle, that, whatever may be the cause of the pain, it ceases when we extract the nerve, or in any other way destroy it. It is necessary, then, in order to remove the pain, to find a mode by which we can cut off the dental nerve at the point where it enters the tooth. It is this to which Fattori has arrived. By means of suitable needles, which he adapts to a trepan, he cuts off the nerve, after having promptly perforated the painful tooth, which becomes, by this operation, ever after insensible."

This operation, unfortunately, is as far from being certain in its results, as it is ingenious and rational. From the knowledge which we have of the anatomy of the teeth, is it always certain that we can strike the nerve in perforating the tooth; and if, as it might ordinarily happen, the operation has to be repeated, what one will be sufficiently patient to endure the pain of a second operation, and honest enough to avow that it is not equal to the loss of the organ? This operation, to say the least of it, is rarely successful; and not much can be gained in performing it upon teeth which have but one root.

M. Malgaigne thinks that, in executing the operation of Fattori, it is necessary, at least for the posterior teeth, to make a large incision in the gum, and finds that some advantage is obtained by *extracting the tooth posterior to the origin of the pain*, in order to permit the proper instrument to be introduced to divide or crush the nerve, to the depth of its alveolus. We will first remark, that if Fattori had ever dreamed of making an incision in the gum, for facilitating the operation he recommends, the remedy truly is worse than the disease. We remark, secondly, that, since Malgaigne recommends the extraction of a

tooth, it would be better to extract that which is diseased ; there are one hundred probabilities to one, that the pain of the operation would be greater than the patient could endure. The manner in which the nerves of the dental apparel are distributed strengthens this belief ; it is certain that the destruction of the nerve of one tooth, a nerve which has nothing in common with the one preceding it, is a means incapable of destroying the one which adjoins it, much less could the destructive instrument reach the common trunk of the nerve, that which would be of great inconvenience, excepting in cases of very intense general dental neuralgias, as we shall soon see, in speaking of nervous diseases of the teeth.

Ambrose Paré and Urbain Hémard have also advised, in case of caries, to excise the crown of the tooth. They call this operation *decapitation* of the tooth, doubtless in opposition to the chaplet that the teeth form over the nerve, by the union of their bony structure ; this operation is followed by cauterization of the nerve. But it is not always exempt from danger ; the shock communicated to organs which are already the seat of an exquisite sensibility, and other accidents that often follow it, have caused it to be neglected by modern practitioners. We perform it constantly only for the six anterior teeth, when we wish to preserve the roots, in order to adapt artificial crowns to them. In order to practice this excision, which is generally very painful, we should, as we shall see hereafter, grasp the crown with excising forceps, or remove the crown by the file.

Some other operations more or less injurious have been proposed for quieting the pain of the teeth and for preserving them. Such as their luxation, extraction and replacement and excision of their nerves ; but we hesitate not to say, that it is more in accordance with the speculative spirit of the age than with a healthful practice that these ideas have been advocated, we do not think that the above should be adopted as general rules of practice.

Exostosis and Spina-Ventosa.

Under the name of *exostosis* we designate hard immovable

tumors, which develop themselves upon the surface of bones, and which it is believed are formed by a swelling, and consist of a true hypertrophied condition of their tissue. The teeth are subject to this affection, but the great degree of analogy which exist between the bones in general, and the roots of the teeth, explains why these last are most ordinarily affected. We say the most ordinarily because there exists examples of exostosis even upon the crowns; we have seen a large incisor upon the anterior face of the crown of which there is a sort of node raised upon the enamel; the person to whom this tooth belongs has observed the gradual development of this deformity, and used efforts to arrest the pains which it occasioned by the enlargement of the alveolus, upon the circle of which the enlargement in its progress toward the root has encroached.

The cause of this swelling of the teeth, when it affects the roots, is very obscure and difficult to perceive before extraction. It exists sometimes only upon the side of the tooth, which presents a rounded or angular form, and, in some cases, it occupies the whole circle and height of the root; in other cases it accompanies the consumption of the root. This disease, of which we possess a great number of examples in our pathological collection, is nearly always the result of engorgement and the ossification of the dental periosteum. It may exist when the crowns are healthy, but it more frequently manifests itself upon subjects whose teeth have become painful, either from indolent inflammation, caused by the decay of the body of the tooth, and which extends even to the roots, or is the result of a gouty or rheumatic diathesis.

It is difficult to prove, in an exact manner, the existence of exostosis of the roots, for it never causes suppuration, and the gum nearly always continues in a healthy state. It may be inferred from the severe pain which accompanies it, pain whose intensity is not always the same, and which, in every case, announces itself after it has acquired considerable size; then the alveolus becomes enlarged by the pressure of the diseased root upon its walls, and this either becomes movable or is forced out by the alveoli, and passes beyond the level of the neighboring tooth, at which point it is altogether opposed to mastication.

Some persons, says Fox, with reason, attribute this kind of deformation to congenital vice of conformation of the root, but as it differs very much from all the defects that the different or badly formed roots of the teeth that are not diseased present, one is compelled to believe that the cause is not a morbid action which occasions an osseous deposit, as in all the other cases of exostosis.

All that art can do in this disease, is to seek, when the pain exists, to combat it by the three odontalgic remedies which we have described in the course of this chapter, local bleeding and topical emollients, narcotic medicines and revulsants. But if the pain continues, so that the tooth becomes loosened, or by its swelling occasions a perceivable deformity, it is necessary to extract it. The example given by Fox,* proves that to delay this operation is prejudicial to those who are affected with this disease. But in doing this we should be careful not to confound it with rheumatic affections of the jaws, and especially with the alveolar arches, of which they are, however, often the seat, and about which we shall soon speak.

As to *spina-ventosa*, it attacks principally the roots of the teeth, but it differs from exostosis, as the swelling is not so compact, but spongy and sometimes lamellar. The cavity of the diseased root is enlarged, its opening is larger than in its normal state, its thin wall seems to have been distended by *inflation*. This disease is very rare; we do not possess a single example of it. It is accompanied by the same symptoms as exostosis, and has the same therapeutic indications.

Softening of the Teeth.

Although authors have made no mention of this disease, it does, nevertheless, exist as an essential affection. The teeth affected with it presents a cartilaginous consistence, denoting that, under the influence of a cause whose nature it is difficult to determine, are deprived of the earthy salts which enter into their

* This author relates the case of a lady, all of whose teeth he was obliged to extract, one after another, because their roots were exostosed.

composition and are reduced to a parenchynea into the meshes of which they are deposited. Those teeth resemble bone which have been in a concentrated acid ; a circumstance which might confirm the opinion of those who assimilate teeth to bone.

We have met with many cases of this extraordinary disease ; one of the most curious was a young subject whose two small molars, one on the right, the other on the left, were reduced to the consistence of wax. Pressure exerted upon the crown by the finger, was sufficient to make them undergo a very evident change. We preserved them carefully as the only well authenticated example of this affection, until we had occasion, last year to speak of it to Dr. Sander, the ancient teacher of cliniques at Rotterdam ; this honorable confrere assured us he had met with a lady who had lost all her teeth from a softening of their tissue. We requested him to give the most precise particulars of this case. His reply, dated 10th of April, 1842, we here quote :

“Having arrived at Rotterdam, I spoke with the surgeon, A. Nortier, who with me visited the lady, Madame D — ; I was confirmed that her teeth was in a complete softened condition ; we could by taking the teeth between the thumb and finger change their shape. Their consistence was similar to the material which the glazier uses for fixing in glass. This lady, aged more than sixty, was very scorbutic, her gums were swollen and a fetid odor escaped from her mouth. She lost all her soft teeth to the alveoli, and these were filled with soft matter, which before constituted their roots.”

As this disease, habitually declared under a deterioration of the general constitution, it is towards this last state that all our therapeutic efforts should be directed ; the office of the dentist in this case should be wholly confined to the extraction of the teeth, as they are rendered by this transformation altogether useless, and very annoying.

Diseases of the Dental Pulp.

In the pathological view which we have presented of caries, we have seen that the severe pain which sometimes accompa-

nies this affection, is in general the result of its invasion of the dental pulp. This pulp can, nevertheless, in some cases, be affected without any traces of caries; and this affection is either an inflammation, a fungus, an ossification, or finally a pure *neuralgia*.

1st. The inflammation of the pulp, in nosological language, is called *odontitis*. It more frequently affects the teeth of adults than those of children, and is generally more common in the commencement of the caries or wearing away, than in advanced stages of this disease, this inflammation is characterised by a sharp pain which is increased by a blow upon the crown of the tooth, and which does not extend at first to the gum or the jaw, but toward the second or third day the inflammation and pain reaches their structures, if however it does not progressively diminish; then all the nerves of the face participates in this pain and are *pulsative*. But the pulsations of the arteries of the painful side are much more accelerated and the beats stronger, whilst in purely *neuralgic* pains they are only much stronger; sometimes, however, without taking this characteristic, the inflammation ceases altogether, and the disease only leaves its traces by a species of bastard paralysis, which accompanies the swelling of the gum. The pain is such that we are obliged to extract the tooth. We perceive the dental pulp, at the extremity of the fang inflamed, tumefied and even sometimes suppurated and gangrenous.

This is not expressing a baneful opinion, when we say that the causes of this inflammation are sometimes the impressions of cold and heat—sudden changes of temperature—violent shocks upon healthy teeth or light blows upon those decayed, or the retention of alimentary particles in the decayed portion of the tooth, or finally a metastasis of disease from other parts. This last cause wants especial attention; for it is to this we can bring to bear a great number of very intense odontalgics, which are completely rebellious to the means which might not be appropriated to their special use. It is thus that we have seen a young man a prey to the most agonizing pain of the teeth, and who submitted to have four, successively, extracted without relief, and which yielded only to a nasal hæmorrhage, to which he was accustom-

ed, which was effected by powders inhaled for the purpose of irritating the mucous membrane of the nares.

As to the treatment of *odontitis*, it ought to be in conformity with the rules for caries, either anti-phlogistic or anti-spasmodic, or over-exciting, or, finally, escharotic. We will confine ourselves to noticing this inflammation in its most ordinary forms, under its least dangerous character; it often happens, as we shall see in speaking of dental neuralgia, properly so called, that the inflammation of the pulp increases the size of the nerve belonging to the tooth, and even affects the brain at the point where this nerve arises, and occasions sympathetic affections in the parts to which the fifth pair of nerves are distributed, or cerebral accidents of a serious nature, against which the extraction of the tooth, which was the primitive point of pain, in most cases, is altogether useless.

2d. When the dental canal has been dilated by disease, or finds itself accidentally opened, the soft parts which it enclosed may be the seat of a *fungus*. If the canal has been dilated towards the extremity of the root of the tooth, the tumefied pulp becomes consistent, reddens, and forms a cord larger than when in a natural state of health, and in this condition remains, with a thickened alveolar membrane.

When the canal is opened by caries or fracture, there appears exteriorly, on the pulp, a small red tumor, bounded by the edges of the cavity of the tooth, and very sensible to the contact of foreign bodies. This sensibility is sometimes such, that mastication is not only impossible on the diseased side, but the patient dares not even close the mouth, for fear that the corresponding tooth, from above or below, should strike upon the fungus.

It happens often that this tumor becomes hardened, falls, and of itself disappears. In cases where this advantageous result does not take place, art should not fail to effect it. It can be effected by excising the fungus, or cauterising it; or, when these means have been used without success, it should be extracted.

The dental pulp may be, as we have said, independent of the inflammation and the fungus, the seat of a true *ossification*, which is caused by two means: either when the tooth is worn

off, then the pulp is ossified at its contact with the table which closes the dental canal ; or, when the tooth is decayed, the extremity of the pulp terminates by a bony fibre, which remains suspended to this pulp ; for, assuming a pathological state, this ossification, according to the judicious remarks of Mayelin, is the result of a beneficent foresight of nature ; for, in the case of wearing away of the bony plate of the tooth, it becomes adherent to it, and augments its thickness ; in the case of caries, it closes the cavity, and prevents the denudation of the parts contained in the dental canal.

But it often happens that this bony fibre prolongs itself in the interior of the canal, compresses the pulp, and occasions the pains, the cause of which it is difficult to determine at first. It is that which we have observed many times, as Rousseau expresses in these words :* “A young man, of about thirty years of age, being tormented with very violent pains in his teeth, presented himself to me, in order to have the tooth extracted, which he believed was the cause of his sufferings. This tooth was not affected by caries, and, in the mean time, I endeavored to convince myself that this was the principal seat of the pain. I extracted it ; not having been able to discover any change in it, I broke it in order to examine the interior, and I found, in the dental cavity, a bony fibre of considerable size. I perceived, then, that this fibre, by its continued growth, irritated the nervous pulp, and pressed it against the walls of the cavity, had caused an inflammation, and was the evident cause of the pains which this young man was a prey to for so long a time.”

This case appears much more frequently than it is believed, even at the present day. We find a remarkable one in an Italian collection.† It is thus stated : “An Italian lady experienced a continual glowing or tingling in her left ear, which appeared to increase daily, and which she compared to the noise of a bell. This obstinate sensation having resisted every remedy, this lady became very sad and hysterical. She had recourse, finally, to Dr. Buzzi, dentist to the court of Tuscany. This

* Work quoted, page 257.

† Medic. Observ. Naples, 1st December, 1833.

physician examined, with the greatest attention, the external auditory passage, the Eustachian tube, and the buccal cavity, and discovered no derangement there. He perceived no caries upon the teeth, which he examined very carefully ; nevertheless, he pierced each, and when he came to the left canine of the upper jaw, the lady perceived the tingling sensation. Regarding, then, this tooth as the seat of the disease, Dr. Buzzi extracted it, and immediately the lady was freed of a disease which had, for a long time, tormented her without ceasing. He cut the tooth in two, lengthwise, and found, in its interior cavity, a small bony fibre, suspended to the nutritive artery, and similar to the clapper of a bell."

Nervous or Dental Neuralgia.

Independent of the different kinds of pain which determine, in the dental system, the different diseases that we have treated of, and which have their primitive seat in the diseased tooth, that is to say, which proceed from the periphery to the centre, the teeth present others, which have no very apparent cause, proceeding from the centre to the periphery, which is dependent upon a direct lesion, either of the nerves distributed to these organs, or from that part of the brain from whence these nerves originate.

The first are generally of an inflammatory nature ; the second, on the contrary, are nervous, and consequently auxiliary, and, in strict medical language, we should give them the name of *odontalgics*. Thus, while some are of an inflammatory nature, which discloses their usual progress, their throbbing sensation, and the rate of the individual they affect, which are ordinarily men, adults, robust and sanguine subjects ; the others are followed, on the other hand, by a brisk and unexpected action, are not usually accompanied by arterial beatings, often take an intermittent form, and principally affect susceptible individuals, who have suffered from long disease, hysterical women, finally, persons tormented with rheumatic affections and transcurrent nervous diseases, which have a strange analogy to rheumatism, and which we commonly designate *rheumatic pains*.

In the odontalgia which we have already spoken of, by the percussion of the teeth upon the place where the pain is felt, we at once ascertain which is the diseased organ; in those in which there is doubt, this method of examination is sufficient only to prove that all the dental range on one side is affected at once. There, all the phenomena are concentrated upon a single point; here, sharp sympathies are put in action; these are otites, tic-douloureux of the face, in a word, phenomena which prove that different divisions of nerves, of the fifth pair, are affected. Thus, as a consequence of this fact, and of those that we have given, whilst the extraction of the diseased teeth, in the case of inflammatory odontalgia, causes the pain to cease, in nervous odontalgia this extraction is a useless operation.

Some dentists, being ignorant of this distinction, daily commit horrible mutilations, and compromise an art, which, properly attended to, would conduct to the best results. Nevertheless, we acknowledge that elementary works, written at the present day, upon this art, are far from having established this distinction, since some of them have not even suspected it; but, in reading with more attention the general treatises of surgery, dentists might have avoided this error. There, in place of seeking to calm all dental pains by local means which we have described, they would seek, at early periods, to employ means more appropriate to the nature of the disease, as revulsives, and applying sinapisms to the legs, or very cold pediluvia, applying cups to the nape of the neck, or even upon the cheek, bark or sulphate of quinine in large doses, narcotics, such as *opii*, *bella-donna*, ether, &c.

Benjamin Bell, an English surgeon, a member of the college of surgeons of Ireland and Edinburg, has confessed the distinction that we have made; he expresses himself thus:* "Under certain circumstances, we perceive that the pain from the tooth depends upon an affection of another part and no remedy will succeed, unless directed towards the primitive disease. Rheumatism is sometimes the source of the disease, or *arthritic*

* A Complete Course of Theoretical and Practical Surgery, translated by Ed. Bosquillon, 1796, vol. 4, page 181.

diathesis ; it is often the symptom of hysteric affections which pregnant women are subject to ; it frequently depends upon a disordered state of the stomach.

Among the sympathetic affections which determine dental neuralgia, there are none which are more frequent than those which have their seat in the organ of hearing. These changes sometimes have a most fatal result, as the following proves, which has been related to us by Dr. Meleg, formerly of the school of Strasburg.

"A young boy, of a good constitution, presented himself at the venereal hospital of Strasburg, affected with a blennoragia and itching. The treatment of these two affections were promptly conducted, but with much prudence. At the end of a few days, a very severe odontalgia manifested itself ; fever, headache, beating of the temporal arteries, &c. followed. He was bled copiously, but this had but little effect ; we then extracted the *decayed* and *painful* tooth. Then pains in the ear appeared, which we endeavored to appease by applying leeches to the mastoid apophysis ; but the toothache continued, and the pain extended to the whole of the lower jaw, accompanied by loss of rest, incubus, frightful dreams, and sharp cries. The violent pains of the ear continued, and assumed the character of a noise like that produced by the blows of a hammer upon an anvil. Six days elapsed, but he still suffered the most agonizing pain. He was now seized by so furious a delirium, that no one could approach him. Although the auditory canal was healthy, all the teguments of the ear and temples were so tender, that the most light contact with them produced the most agonizing pains. The delirium and fever continued, accompanied by spasmodic motions of this lines, great dilation of the pupils of the eye, continued weeping, rattling in the throat, a lethargic state, and, finally, the death of the patient, after eight days of the most excruciating sufferings.

"On opening the subject, the brain was found penetrated by a general vascular injection ; in some places its substance was similar to sand ; the dura mater, corresponding to rock, presented a remarkable redness, and was lightly raised in reference to the superior semi-circular canal. The incision of the mem-

brane caused a small quantity of reddish and clotted pus to flow. After having washed the surface, we perceived that the walls of the canal were decayed, and that they had evidently communication with the labyrinthial cavities in which the pus had formed which flowed from the dura mater. Moreover, the pus had the same consistence that the morbid products which are found in the interior of the ear, whose membranes were red, thick, and seemed softened. The middle ear appeared untouched; on examining the mouth, we found many of the teeth decayed *only at their roots.*"

It might be asked, what was the primitive cause of all these disorders? We do not hesitate to admit that odontalgia was. The pain which accompanies it increases, and is propagated to the brain, and is limited by causing, in this last organ, a primitive sympathetic disturbance, but which, under the incessant action of the odontalgia, locates itself in the cerebral centre, and radiates towards the internal ear, where it locates itself with an energy as much greater, as the organ affected is more delicate, and as the patient finds, in the noise of the great hospital, a cause of excitement sufficient to aggravate his disease; for every one knows how prejudicial noise is to persons affected with otitis.

That sympathy so intimate which unites the dental apparel to the organs of the ear has, however, been noticed long since; thus Ilard, Deleau, and most physicians which are occupied in a particular manner with diseases of the ear have often sought to prove the original cause of nervous surditities, which date their first existence from a primitive and concurrent injury of the dental apparel. No author, however, has given a satisfactory explanation. Jobert says, in reference to this subject,* "we should, nevertheless, seek an explanation of this fact from the anatomical arrangement of the different parts. Examine, then, the relation between the chorda tympani and the dental and lingual nerves, as the termination of this same *chorda tympani* as in the facial nerve, of which it appears to be only a branch; notice, then, the anastomosis of this last nerve with the acoustic

* Studies upon the Nervous System.

nerve in the internal auditory channel, and you will probably be in the right track. I believe, in effect, that is the result of the nervous distribution that we can attribute the surdity which accompanies the phenomena of dentition."

This explanation, says Mueg,* seems to lack exactness. It is established daily, that the anastomosis are only of juxta positions; that the nervous fibres, after the reunion of the two roots never unite together; they proceed separately, and independent of each other; and that, consequently, there can never be the least conflict between them, excepting in the case of nervous sympathy. (We have already made this observation on page 257, in speaking of the proposition that Malgaigne makes in order to destroy the nerve which belongs to one tooth in order to calm the pain which is felt in the preceding one.) We draw two conclusions from thence; first, that the pain neither irritates it, pathologically, or mechanically, nor can it transmit itself to the different organs by the anastomosis of their nerves; secondly, that each time that a pain co-exists sympathetically in a part with the pain of another region more or less distant, it manifests itself by a reaction of the nervous centres. We can thus explain perfectly the auricular sufferings which so often accompany odontalgia, and vice versa; hence these always result from the phenomena of reflection."

We may now definitely conclude that all the pains which are felt about the teeth are only the result of a physical alteration of their substance; that, whatever may be the cause from whence they proceed, they may radiate towards the brain and produce serious effects; finally, that the dentist who employs no other means but extraction, will sometimes be exposed.

In every case, when a dental pain is evidently of a nervous nature, two kinds of means present themselves for our consideration; the one is under the jurisdiction of the medical matter, the other belongs to the operative physician. The first are placed in the numerous class of anti-spasmodics, as opium, which is principally administered under the form of salts (*acetate or*

* *Of Electricity applied for the cure of Surdity, Review of Specialities, September, 1842.*

hydro-chlorate of morphia) by the endermic method, that is, by the deprivation of the skin of its epidermis, in doses of from the fifth of a grain to a grain; henbane, datura stramonium, belladonna, that Deleau pretends to have employed, with the greatest success, under the form of cataplasms, in all neuralgic affections of the face; afterwards the asafœtida, cherry leaves; finally, he employed cups, blisters, by the epidermic method, that is to say, after having deprived the skin of its epidermis, to administer doses of from the fifth of a grain to a grain; Deleau pretends to have employed with the greatest success under the form of cataplasms, in all facial neuralgics, as guaiacum, datura stramonium and belladonna; afterwards, asafœtida, cherry leaves; finally, blisters, cups, moxas, etc. If, as is sometimes the case, the pain takes an intermittent form, we should not hesitate to administer sulphate of quinine.

Another means which belong to operative medicine, and which should never be employed unless the first have failed, consists in separating the dental nerve from the common trunks which are the superior and inferior maxillary nerves. The first we attack at the point it leaves the sub-orbitary foramen by cutting it in the interior of the mouth, or, to speak clearer, towards the internal face of the lips or cheeks by a simple puncture or by an incision as recommended by the elder Berad; and the second according to the directions of Warren, Velpeau, the elder Berad, Malgaigne, to the works of which we refer, persuading dentists at the same time not to take upon themselves the responsibility of similar operations.

PHYSICAL CHANGES OF THE TEETH.

The Wearing Away of the Teeth.

The wearing away of the teeth, considered in itself, properly called is not a disease; it constitutes rather physiological phenomena, which is the inevitable consequence of the exercise of these organs. It is not only when the wearing shows itself among young subjects, and when it progresses with rapidity, or when the destruction of the teeth amongst more aged persons, is

sufficiently great as to give place to accidents, that it should merit the attention of the pathologist.

In wearing away, the teeth diminish in height in proportion as they are employed. This diminution, show amongst all individuals whose dental apparel is complete, regular and well situated, is much more rapid among those who wear a greater or less number of their teeth (those which being well arranged are submitted to more frequent use) or among those who have them badly arranged.

Numerous circumstances contribute to cause the wearing away of the teeth; such are, as predisposing and occasional causes, then friction during mastication, their delicate texture, the chemical influence that certain aliments exert upon them, the employment of certain dentifrices which are not well ground, that of acids, the use of earthen pipes, which should always be furnished with fine wires, the habit of chewing upon one side, the action of breaking hard bodies in the mouth, the grinding of the teeth resulting from a convulsive action of the muscles of the jaw, that we observe principally among persons during sleep, &c.

Wearing attacks particularly the parts which touch in the meeting of the alveolar arches. Thus, we observe it principally upon the triturating surfaces of the molars, upon the anterior parts of the superior incisors and upon the posterior of the inferior incisors; when the first generally, as we have often remarked, have deviated inwardly from the line representing the curve of the alveolar arch. In order to be convinced, the touching of the teeth is the principal cause of their wearing away, it is only necessary to examine the state, even at a very advanced age, of the incisors of that species of bull dogs, whose inferior jaw makes a large projection outwardly to the superior. These teeth preserve at all times the form of a *fleu de lis*. Now, we know that, in the canine species this conformation of the incisors is regarded as an indication of youth, and its disparity as a more equivocal sign of the contrary position. This form undoubtedly disappears because the continual contact of the teeth, either between themselves or between them and other hard bodies, has worn only the tubercle or projection the union of which three forms the *fleu de lis*.

Besides, particular circumstances often vary the manner by which the teeth are worn away; we have observed, that the incisors are worn away more rapidly when the molars are wanting; and the same is often the case, *cæteris paribus*, with the latter. As abrasion of the teeth is common to all, and as it increases with years, it would seem probable that inductions hence might be drawn, with regard to the age of individuals; but this is not the case, because it is caused either by irregularity of the teeth, as in the case of which we are about to speak, or by the difference of food; it exists among persons who have suffered the loss of a considerable portion of the substance of their teeth at an early age, whilst among others this loss is scarcely manifest, even at an advanced age.*

Although the wearing away of the teeth is not rendered very evident until advanced age, it is no less true that it no more spares infancy than old age. In effect, if we examine the teeth of a young subject, whose first permanent molar has appeared, and if we compare it with the neighboring milk molar, which should be immediately replaced, we see that the tubercles of the first are elevated much above the deep sinuosities which separate them, whilst those of the other have entirely disappeared, or are nearly level with the rest of the surface, and only present between them imperceptible sinuosities. These sinuosities have a yellow and dull color, whilst the parts which surround them are of a brilliant white; this is of the greatest importance to be known, in order to prevent mistakes in extraction. Whilst the enamel is not destroyed, the triturating surfaces of the teeth remain white; but when the ivory can be perceived, we observe, at first, in the centre of each tubercle of the crown, a yellow spot, which gradually enlarges, until the layers of enamel disappear; the tooth then presents nothing more than a flat surface, more or less unequal, of a yellow color,

* In veterinary medicine, this wearing away is the index most constantly consulted, principally in the horse species, for determining age. But horses being accustomed, generally, to the same kind of food and care, the wearing away of their teeth ought to be the same among them. This opinion, however, has often caused serious errors to be committed.

its circumference bordered with enamel, and leaving, in the direction of the dental canal, a spot of a deep yellow or blackish color.

The first indications of the wearing away of the teeth are, a great sensibility, a setting on edge easily by acid or sweet substances, and by impressions of heat and cold. In proportion as it increases, the sensibility becomes more intense, and sometimes replaced by incessant pains. If the individual has very delicate teeth, if the painful impressions are renewed too frequently and with too great intensity, the dental pulp participates with this morbid state; it inflames and suppurates; from thence follow very acute pains, and an inflammatory swelling of the neighboring parts, which the meeting of the jaws increases, and which yield only to extraction.

These are more common than one might believe. Most commonly, it is limited by exciting the functions of the pulp, which, stimulated then, assumes a greater vitality, and preludes a kind of bony cicatrization, consisting of a deposit, in the interior of the dental cavity, of an earthy substance, which strengthens the ivory by a new interior layer. This new substance, of which we have already spoken of in the ossification of the pulp, which forms and increases principally upon the side of the worn part, and which Rousseau names the osselet, was already known to Hunter and described by others.

It absolutely resembles the other parts of the teeth; sometimes more yellow, yet it is always as transparent and as brittle; it assumes no regular structure, detaches itself from the dental cavity, and isolates itself altogether from it, and the sides which correspond to this cavity are much more dense than its interior surface. The portions of worn teeth are then reproduced; but this addition of osseous substance is a cause, often, of their destruction without pain. It is in consequence of this addition, which insensibly takes the place of the stony pulp, and which, in filling the cavity, destroys the sensibility of the teeth, that old men are less subject than young to dental pains, or have these pains infinitely less intense, because, amongst them, the central canal is not penetrated by the air, nor by other strange bodies.

We say, that the parts of teeth that are worn away are not

reproduced ; consequently, for the treatment of this, it is not only necessary to remedy the loss, but to suspend and destroy the cause which occasions it. Thus, when a tooth is worn away by the friction against the opposite one, we can diminish this last by the file ; this is applied principally to the incisors or canines. The different forms which abrasion gives to the teeth produce irregularities which injure the neighboring parts ; it is necessary to remove them by the same means. We advise, that as such dentifrices as may be too rough, and such drinks as may be too acid in their nature, and which may be the cause of the wearing away of the teeth, that they should not be employed.

But if the tooth becomes too much worn, or too painful, we might perforate the dental cavity, and afterwards plug it ; and if this operation is impossible, we might cauterize the crown of the tooth, which would remain then insensible. As to persons subject to grinding their teeth during sleep, they affirm that if they place a piece of linen, cork or any other hard substance between their jaws, in the night, that they can avoid the consequences.

Cracks and Fractures of the Teeth.

Cracks in the teeth, which are, to speak plainly, but a small fracture, causes no morbid change, for it is superficial. A number of causes produce it ; they are, perhaps, occasioned by the grinding of the teeth, by convulsions,* by the contact with hard bodies during mastication ; sometimes, by the effort exerted by the jaws to break hard substances ; sometimes by blows and by falls. The pain, at the moment that the crack takes place, is more or less severe, according as the loss of substance is more or less great ; afterwards, for some time, it is more or less sensible of impressions of cold, heat, acids, or by the contact of hard bodies. We can limit, as in certain cases of the wearing away of the teeth, the fractures of the teeth, by filing their angles, in

* We have seen, in a house of health, a young lady of fourteen years, affected with general convulsions, which were so violent and tumultuous to the jaws, that after some days the whole cutting edge of the anterior teeth had successively disappeared by fractures.

order to prevent them from cutting the soft parts of the mouth, and also in order to give the teeth a more regular appearance.

Whatever resistance the texture of the teeth may offer, they are, nevertheless, susceptible of being completely broken by fractures, not only in consequence of exterior violence, as a blow, a fall upon the face, and an improper attachment of artificial teeth; but still by the simple closing of the mouth, by the compression of the jaws, etc.

Most ordinarily, it is true, they possess a predisposing cause to this accident, in constitutional disease, as the scurvy, rickets, scrofula, syphilis, or any other affection capable of breaking them, or in a local affection, as caries, atrophy. Sometimes we see healthy teeth fractured crosswise, without any apparent cause. Laveran gives an example of a small molar. Duval has also observed, upon a man of sixty years of age, the two bicuspides of the superior jaw fractured lengthwise, without a blow or without pain: we ourselves have met with similar instances.

As for the rest, a tooth may be fractured at its crown, at its neck, or at its root; the fracture may be complete or incomplete; take a longitudinal, transversal or oblique direction; finally, it may be simple or complicated, that is to say, exempt from or accompanied by the contusion of the neighboring bony or soft parts.

Some ancient authors thought that a fractured tooth cannot be ossified. They say, *the teeth are exposed to the action of the air, and of the surrounding cold air, an obstacle in the formation of osseous matter.* They add, *no agglutinative fluid can flow from the teeth, on account of the dryness of their substance; or, if it flows from them, it is very much diluted, and has not the necessary qualities for consolidating the parts, on account of their small quantity of heat.*

This explanation proves they were far from entertaining an exact view of the manner by which the two fragments of a broken bone may be consolidated; besides, it applies only to the crown of the tooth, the only part which may be *affected by, and exposed to the cold of the surrounding air*; finally, it rests upon a fact which the researches of Behu, Jourdain, and, more

recently, those of Duval, etc., have proved erroneous; they have demonstrated, in an incontestable manner, by experiments upon living animals, that the fractures of the crowns can, as well as of the roots, be consolidated. The procedure which nature employs to effect this end, differs, nevertheless, from what we observe in the union of fractured bones; that which exists in the difference of organization between the teeth and other osseous structures; the adhesion of the fragments of teeth is not effected between their extremities, but results, universally, from the formation of new layers of ivory, furnished by the pulp, which layers extend themselves between the parts, in order that they may unite themselves, as it were, mechanically together.

The result of these observations is, that in order that adhesion may take place, it is indispensable that the fractured parts remain in contact with the pulp, and that this tissue does not suffer too great a change. It is not, then, affected by a cicatrix of dental bone; this is so true, that when a space exists between the fractured extremities, the union is effected no less by it, although the primitive separation exists.

Fractured teeth are more susceptible to the action of external agents than those which have been simply cracked. This susceptibility, sometimes so great as to be attended by pain, exists to an indefinite period after the fracture has taken place, and even extends upon the layers of ivory furnished to the interior of the tooth, by the pulp, have been completely developed. As to the rest, teeth which have experienced the action which we have described, lose their brilliancy, and become yellow or black: it is, nevertheless, to be remarked, that they seldom decay, unless a cavity is formed by the fracture.

The superior incisors are the most subject to fractures, because their position exposes them most frequently to mechanical injuries from without. When the fracture is small, consisting of a simple crack, the greatest inconvenience resulting from it is, that it causes asperities capable of irritating the neighboring parts; it is always easy to remove them, by using the file. If the loss of the enamel injures the form of the crown, and renders it necessarily less fitted to perform its functions, it, how-

ever, does not draw, as we know, the loss from the tooth, although it can lessen much of its hardness, and become broken by a premature age.

It is not necessary to believe, as some authors, that the loss of the substance of the teeth always has an injurious effect. Fox principally considers the enamel as not being absolutely indispensable to their preservation. To strengthen this opinion, he quotes examples from many savages of India and the interior of Africa, who are in the habit of giving to their incisors a strange form, and that of individuals, who, after having filed their teeth, have preserved them to old age.

These examples prove nothing, if only superficial changes of the enamel are not always injurious, although, in the part we have devoted to caries, we have proven the necessity of separating teeth with a file, for the removal of caries. But it, at the same time, establishes the principle that, in all cases where great portions of the crown of a tooth have been fractured, it constitutes a serious injury, which, sooner or later, results in the destruction of the injured organ. We can even, in order to prove that we do not exaggerate more the innocence than the danger of the loss of the enamel, quote examples given by Fox, of caries which affect the teeth of the Malay Indians, after having had horizontal grooves cut across the anterior surfaces of their crowns.

It is principally where the ivory is exposed to the action of external agents, that fractures, when of considerable extent, become dangerous. As to the means which art has to oppose their effects, they vary according to the nature and extent of the fracture. If the fracture is confined to the crown, without extending to the pulp, the tooth can be preserved; it is, however, necessary to guard against inflammation, which may develop itself, for if this occurs, the tooth may become the seat of excessive sensibility, which it is necessary to remove immediately, by cauterizing the fractured surface. The deformity which might result from it may be corrected, by slightly diminishing with a file the height of the adjoining teeth, if that can be done without danger. When the pulp is almost entirely exposed, cauterization is still more necessary; afterwards the tooth should be plugged.

When the fracture extends to the neck of the tooth, which is always a serious accident, and always causes great local disorder, independent of the most acute pain, the procedure of the dentist should vary according to the age of the patient. If an adult, after having subdued the inflammation, it should be cauterized with a red iron; then, after some days, the root should be filed to a level with the gum, and either plugged or a tooth engrafted on it.

But if the subject is young, this procedure, in most cases, would be a feeble resource, for the teeth at this time possess a vitality which renders them very susceptible to the action of foreign bodies; besides, their roots are not completely developed; they may then become the seat of different affections which hasten their loss; it would, then, be very hazardous to attempt to preserve them at a later period, by inserting artificial teeth. This is an important branch of practice; we recommend it to the attention of our professional brethren; experience will prove that the most rational course among young subjects, is to extract the tooth. The space caused by it will gradually disappear by the approximation of the adjoining teeth, but if it should remain, it will be but a slight inconvenience compared with that which would result from the presence of a foreign body, as a plug or false tooth, introduced into a root possessing great vitality.

With regard to fractures which extend lengthwise to the root, we should not hesitate for a moment to extract the loose pieces. If we delay too long their removal, their presence in the alveolar cavity will be the occasion of violent pain, inflammation, of abscesses, and of other serious accidents, which will not subside until the total extraction of the fractured tooth. If the crack does not extend to the root, we can seek to unite the two divided parts by a ligature, which will maintain them joined lengthwise, we can then avoid the inflammation of the pulp and fistulous abscesses.

Finally, in order to conclude this article, we say, furthermore, that the fractures of roots are not always easy to be perceived; but they constitute, in every case, a serious accident, not by the solution of continuity in itself, but by the injuries of the pulp and of other parts contained in the alveoli, by which they are

most ordinarily accompanied. Thus, the best course to take as regards this, is to extract the tooth. Notwithstanding the advice of some authors, who, as we have already said, have pretended that these fractures can be consolidated, and the observations upon which they support them, we still advise, in these cases, the rules which we have given to be followed, and which, being applicable, if not universally, at least in most cases, will always provide against grave errors.

Concerning Accidental Luxation of the Teeth.

The causes which occasion the fracture of the teeth can, without doubt, act in a less degree than those which cause a solution of continuity. Then, in place of breaking, the tooth experiences but a simple displacement, that is to say, changed inwardly or outwardly, and departs more or less from its alveolus. This displacement may be simple, or complicated by contusions, by wounds of the gums, by fractures of the alveolar borders, and even of the jaws. The incisors and canines are more exposed to luxation than the others. There are two reasons to account for this: the first is, that, though firmly implanted, having but one root, they yield easily to the influence of exterior violence; the second is, owing to their situation, they are less protected than the others.

These luxations may be complete or incomplete. In the first instance, all the treatment, as good sense merely shows, is to replace the tooth in its primitive position, and to secure it there by a ligature, being careful, at the same time, not to attach it to the adjoining teeth, which might soon become so unsteady that they would be placed in an inflammatory centre, but either to the second or third.

If we have reason to believe that, in the various movements of the jaw, this luxated tooth will come in contact with the opposite one, it will be necessary to remedy this by applying a light plate of platina, of gold, or any other substance upon the neighboring teeth, to prevent the meeting of the jaws. During the first week liquid aliments should be used, and during the second, aliments easy to be masticated; this will assist in the

consolidation of the teeth, which is not sometimes accomplished for a fortnight.

We have treated merely of simple luxation, but the case may be more serious, and extend even to the raising of the tooth, with the complete destruction of the natural adherences which retain it in its alveolus; that which occurs, for example, when a dentist extracts one tooth for another. His conduct here should be the same as in the preceding case; it is necessary, after having examined the mouth with care, to replace the tooth, and to wait, not that he may take nourishment, as is customary, however, among some practitioners,* but that the surrounding parts may be adapted to it, in order that it may solidify, as in the natural state. That which convinces us that a tooth implanted has ceased to live, is, that it takes a yellow or dull grey tint very soon; for the pain that it seems to feel when we pierce it, is the effect that the shock determines in the neighboring parts, but not the result, if we may speak thus, of a sensible vitality. We shall treat again of this subject, in speaking of dental transplantation.

It is nearly useless to observe that the consolidation of luxated teeth is subordinate to two conditions: the age of the subject and the state of the surrounding parts. To this effect, we know that at twelve or fifteen years the orifice at the extremity of the root allows the nerves and blood-vessels to penetrate it with a facility which permits a free action upon the tissue of the tooth; we conceive, then, that if the luxation was the result of a fracture of the alveoli, or of a violent contusion of the gums, the inflammatory work which results from it will be more unfavorable than propitious to the reunion of the separated parts. This is the case with individuals of a bad constitution, whose gums

* Fox says he has seen a replaced tooth perfectly firm in its alveolus six hours after having been extracted. Bell, who we have already quoted, in treating of the different characters of dental pain, even believes the possibility of the intimate union of a transplanted tooth; he expresses himself thus on this subject: "This operation is suitable only for young men and adults, for it succeeds only, as it appears, when the tooth contracts a direct union with the contiguous parts, by means of the blood-vessels which communicate between them."

are constantly bleeding or choked up, the replacement of the luxated teeth, and, with a greater reason, those that have been extracted, never has a favorable result; the first should be extracted, and the latter operation prudence would require us to omit.

Of the Loosening of the Teeth.

Instead of being fractured or luxated, the teeth may simply become unsteady or loosened in their sockets. The causes which determine this accident are exterior or physical, interior or constitutional.

Exterior causes are, as one would suppose, violences which have not been sufficiently great to cause a fracture or luxation; to those causes it is necessary to add acts belonging to our art, as a ligature or a brace improperly applied, a support badly taken, and, finally, the incrustation of a tooth by tartar, which has extended even to the root, by introducing itself between its neck and the gum.

The interior or constitutional causes are the different changes which the softened and spongy gums experience by the effect of a scorbutic or scrofulous diathesis, by a rheumatic or gouty affection, by a severe disease, by the use of mercury, by inhabiting places where the vapors exert an unfavorable chemical action upon the teeth, and, finally, from many diseases of the alveoli; the critical age, among certain females, is sometimes, also, the cause of it. But, of all, the most frequent is old age.

This difference in the causes of the vacillation of the teeth draws from it one, necessarily, in the choice of the means to be employed to remedy it. Is it the result only of accidental causes, we confine ourselves to treating of local phenomena, to prescribe the use of aliments easy of mastication, to warn the patient of the danger he might experience in testing improperly the solidity of his tooth by touching it with his finger or tongue; and we advise him to use, in the course of the day, many gargles with water sharpened by a tonic sipatous liquor. If the accident is occasioned by ligatures, bands or resorts, it is very plain that their solidification is subordinate to their removing; it is the same case with tartar, that it is necessary to destroy,

and of the excessive length of a corresponding tooth to that which vacillates, which must, of necessity, be shortened.

Unfortunately, the process passed through is not as simple when the teeth are loosened by an interior or constitutional cause. This is the cause that must, before all, be opposed; the teeth become tightened of themselves, by the treatment which belongs to them. It is, nevertheless, nearly always proper to second the efforts of nature by emollient lotions, tonics or astringents, according as the parts which envelope the tooth offer the appearance of a tumefaction, sponginess, or of an œdematous swelling; for we regard this assertion of Maury as an error, or at least as a great exaggeration: that "the loosening of the teeth may be considered as an affection which is dependent rather upon the state of their tissue than upon that of the parts with which they are in connection."

DISEASES OF THE DENTAL APPENDAGES.

Diseases of the Gums.

The gums are composed, as we know, of a very vascular substance, eminently susceptible of swelling, by the least irritation, and which adheres to the necks of the teeth, which it surrounds on all parts, as also the alveoli, whose exterior walls it envelopes.

When healthy, the gums are strongly attached to the teeth, immediately above the alveoli, and their edges rest upon the enamel. Firm and of a rose-white color in their natural state, smooth and united in infancy, irregular and scolloped in the adult; hard, resisting, semi-cartilaginous in old age, they not only participate in the affections of the teeth, to which they are united by intimate relations, but they are themselves subject to many changes, of which the nature of their tissue and their position explains the frequency, and in the course of which they inflame, tumefy, ulcerate or produce excrescences.

Sometimes, as we know, the gums become the seat either of more or less acute inflammations, which often terminate by supurations, and give place to abscesses, or of apthæ, pains, exco-

riations, fistulas and of ulcerations; sometimes they diminish in volume, so as to scarcely cover the alveolar borders, or they enlarge and swell, so as to give birth to fleshy excrescences, that are often difficult to make disappear; changes that, in order for us to conform to the order generally adopted, we shall divide in three sections: firstly, inflammations and swellings; secondly, ulcerations; thirdly, tumors, excrescences and fungi.

The first includes, therefore, inflammation, followed by the perforation of the gums at the time of dentition, apthæ, abscesses called purules, suppurations, dental fistulas, to which we have added abscesses of the maxillary sinus; finally, the adherence of the gums with the cheeks and lips. In the second, we find scurvy of the gums, gangrene, different changes considered as results of scrofula, of syphilitic virus, and of the use of mercury.

Finally, the third section comprises a description of excrescences, designated under the name of epules, and of some other tumors of the same nature.

Inflammatory Diseases of the Gums.

Of Inflammation of the Gums, resulting from the Cutting of the Teeth.—In treating of the physiological phenomena of dentition, we have already designated the inflammation of the gums as one of the ordinary accompaniments; and, in the chapter devoted to dental hygiene, we have described some of the principal means for preventing it. But, whatever precaution we may take, however good the constitution of the child, it is rare that it does not experience some ill effects from it; and we repeat it here, that no doubt may be left of our opinion regarding it, although the frequency or at least the dangers of this inflammation has been many times exaggerated, it is no less demonstrated by experience, that it can, in some instances, be carried to a degree capable of giving serious injuries.

We shall not return again here to the determining cause of this phlegmasia. We are compelled, for many reasons, to regard it as a consequence of the action of the teeth, which, being elevated above their alveoli, advance and push towards the interior

of the mouth through the gums, which are too little disposed to yield to this influence. We even believe this explanation as applicable to the cutting of the second as of the first teeth ; for if, in this latter case, it resists so much as to prevent the eruption of the teeth, in the first, being altogether more dense and hard, it is less easily distended, particularly if the premature cutting of the gum has cicatrized, which the permanent tooth, of necessity, has to break through.

At one period or the other, the inflammation of the gums may be so violent as to extend even to the face, and determines, principally, either that which is commonly named fluxion, or a similar state, upon the mucous membrane which lines the eye, the internal ear, the nasal fossæ, or a swelling of the sub-maxillary glands, and of the lymphatic ganglions which surround the neck. Accidents may be much more serious yet, especially at the time of the cutting of the large molars of the inferior jaw, a cutting which may cause extensive abscesses, which are, unfortunately, liable to open exteriorly, and sometimes to invade the maxillary bones. We also conceive that if this occurrence follows the eruption of the temporary teeth, it may cause the destruction of the germs of the permanent ones, and, by the absence of these last, change, as we have already said, the features of the face.

In considering this inflammation only as the result of a mechanical cause, we necessarily simplify the treatment ; to soften the swollen gum, or to open a passage for the tooth in the right place, are, in first dentition, the two indications to be fulfilled. It is principally with the milk of the mother, as all authors say, that this softening is effected. We find, from this, the means of appeasing the thirst with which the infant is always tormented, and of assuaging the local pain. If it is already weaned, we must have recourse to the mucilage of flaxseed, gum arabic, althæa, to which we add a little honey, and when the gums are harder, with a small brush, or with a piece of the root of althæa, or with the finger.

If these means, employed a certain length of time, do not succeed, a passage must necessarily be opened for the tooth ; but this operation, in order to meet with that success it should, is

subjected to certain conditions of opportunity and execution, which certain young practitioners are generally too disposed to despise. We then repeat here, that the section of the gums is indicated when they are very firm and hard; it can be discovered by touching it, and when we perceive, at the place of contact of the tooth with the gum, a white spot, which is circumscribed by the general redness of these latter.

The incision will be, on the contrary, contra-indicated, if the gums are very much swollen, and if the inflammation is very acute; for besides, the pain, *cæteris paribus*, is much more intense, the vessels being filled with blood, it may happen that a section of them may occasion a hæmorrhage, which, though in general not very considerable, is sometimes embarrassing, either by the difficulty of suppressing it, or by the trouble which is experienced from the blood flowing into the mouth or passing into the stomach.

As to the manner of incising the gums, this is of some moment. Some authors, after having acknowledged the necessity of the operation, pretend that a simple scratch, made with the nail, is sufficient, and abandon it to the nurse. This is a gross error, which common sense would at once refute. A simple separation of the gums will not assuage the symptoms, or accomplish all that may be obtained from the resources of our art; it is even more capable of giving rise to evils than of remedying those for the relief of which it is employed; for experience demonstrates that the unequal tearing of the soft parts, even of those not inflamed, may occasion the most serious nervous disorders. These lacerations are even true wounds, which do not prevent accidents from having their course, nor does it remove them, because the tension of the periosteum will be often an obstacle to the free cutting of the tooth. All observing practitioners agree upon this point, that a simple incision is not always sufficient to subdue the effects which result from the tension that the gums experience from that part of the tooth that seeks to make its way through it. John Hunter relates that, being called upon to visit a child affected with convulsions, caused by a difficult dentition, and which had resisted all the anti-spasmodics, and most of the other means known; he caused

this alarming state to subside in less than a half hour, by scarifying the gums as far as the teeth. But as he did not extend his incision sufficiently far, the gums cicatrised from the immediate contact of the edges of these small wounds; the teeth continued to grow, and to increase beyond the space which the scarifications had procured for them, the convulsions returned, and he was obliged to renew his operation, which caused them to subside as promptly as the first time. At the present time, similar instances have been presented to us.

It is, then, important that the incision of the gum, inflamed by the action of the tooth, should be well executed, that is to say, completed. We believe that which is made by a crucial incision is preferable to any other, because it better prevents a reunion of the lips of the wound, and more easily permits the excision of the shreds, which is often necessary to be practised, in order to expose the tooth. We may, although some authors say that they can determine what teeth this should be practised upon, give the crucial form to this incision, provided we take all the necessary precautions which the case requires. This remark appears to us useful, in order to prevent practitioners who are too timid, in equal cases, from submitting the child to the difficulty for the cure of which he had practised the excision. We shall return again to the selection of the instruments, and the proper procedure of the operator.

Aphthæ.—The ancients give this name to nearly all the superficial inflammatory diseases of the mouth. We find, in effect, under this denomination, in their writings, simple erythema, psuedo-membranous affections, exudations of a soft and cheesy substance, true ulcerations and gangrenous eschar; some have still more augmented this confusion, by adding the gangrene to this order of diseases.

But the actual state of pathological anatomy does not permit us to confound, under a generic name, entirely different morbid changes; we have restricted the history of *aphthæ* to all the light phlegmasia of the mouth, of which we shall treat, and which name we will reserve for eruptions of vesicle or round forms. Thus, then, we mean by *aphthæ* a kind of eruption of superficial or profound whitish tubercles, which develope them-

selves particularly upon the mucous membrane lining the internal surface of the mouth, and which reaches, sometimes, the vale of the palate, the tongue, the pharynx, and even the intestinal canal, or air tubes.

This eruption commences by a small, transparent, white or pearly vesicle. At the first, or as late as the second day of its appearance, a grey or white swelling, hard at its base, develops itself above and around the vesicle, and gives it the appearance of a small pustule. This pustulous character develops itself the second or third day, because the vesicle bursts and allows the transparent liquid which it contains to escape, and is replaced by a more or less painful ulcer.

This second period of aphthæ, which we might call the period of ulceration or suppuration, is prolonged, ordinarily, many days, and sometimes even one or two septennaries. During its continuance, the swelling it presses down by degrees into the level of the surrounding parts; the ulceration enlarges, and is limited by a small red circle, which announces, ordinarily, the tendency to cicatrization. This third period, viz. that of cicatrization, proceeds very rapidly until the small ulceration is cleansed, and often it is over that day or the one following, without leaving any other trace upon the mucous membrane than a small red spot, which soon disappears.

Such are the general characters of aphthæ, which sometimes is *distinct* and proceeds more or less rapidly; again, on the contrary, it is *confluent*, and proceeds slowly, that is, it is stationary.

Distinct aphthæ attacks, as if by preference, children who do not suck, and adults. The pustules are then always isolated, less numerous, and occupy only the mouth; the eruption proceeds, in most cases, without fever; however, it is sometimes accompanied by febrile action, with gastric and intestinal disturbance; we regard it, ordinarily, in this case, as symptoms of fever. This very mild disease is observed in all countries and in all seasons. It is, however, much less frequent in France than the *stomatic*, characterized by small psuedo-membranous plates, which is daily taken for aphthæ. *Distinct aphthæ* proceeds through all its phases in the space of a septennary, and, although it may be sometimes accompanied by a kind of severe local pain, it does not give place to serious affections.

Confluent aphthæ has a slow course, in opposition to distinct aphthæ, which has often lasted four or five days. It is rarely confined to the mouth, for it extends, nearly always, to the pharynx, and even to the intestinal canal. It attacks particularly adults, but principally women in childbed, and it can assume a very serious character. It commences, nearly always, by chills, headaches, fever and vomitings. These symptoms calm, in most cases, after the eruption, the fever diminishes continually, and it is even accompanied, sometimes, by paroxysms more or less decided. The fever appears again, not only after the eruption, but is one of its symptoms; whilst, on the contrary, in ephemeral aphthæ, fever, when it exists, is either accessory or simply concomitant, but is dependent upon another cause than eruption.

In this second variety, the inflammation of the mouth is much more intense and extended; this cavity is hot, and cannot bear the impression of the most mild liquid, as the pain is acute. The disease takes often, in certain cases, a still more serious character. Then there is difficulty of swallowing, on account of the number of pustules, varying in size, which we observe upon the veil of the palate, and in the back part of the mouth. Often respiration is constrained, there is heat about the breast, hoarseness of the voice, extreme dryness of the buccal mucous membrane, upon which we see a number of small pustules, very similar to those which appear after the varioloid eruption; in this latter case, it is very common for it to occupy the interior of the mouth.

When the eruption extends to all these parts, and is very confluent, as we have had occasion of observing, the patient is tormented by pain in the præcordial, by anguish, by nausea, and even by vomitings. If the eruption extends to the intestinal canal, abdominal pain, diarrhœa, and often even of typhoid symptoms, accompanied by other phenomena which we have noticed, and then the disease may sometimes be prolonged to the third week. When the disease is intense, the pustules soon form a crust, similar to thickened and coagulated milk. The volume of these crusts increases rapidly, and their color becomes yellowish or brown. Finally, it soon forms a scab, after removing which, we perceive an ulcer of a reddish brown, from

whence flows a fetid matter, and which, when it is extensive, may cause gangrene, and, in a great number of cases, death.

Notwithstanding the numerous dissertations upon aphthæ, it has been difficult, even at the present time, to determine its true causes. Authors have uttered, as it regards this, very simple probabilities. We believe, however, to have observed that it appears, most ordinarily, under the influence of a humid temperature, and that it was most common in cold and marshy places; also, we have observed it more frequently in autumn than in any other season, and most commonly in Denmark, in Holland and in Zealand. But that which appears to be most certain is, that it attacks, by preference, children and old men, individuals of a lymphatic and debilitated constitution, those which are subject to catarrhal affections; finally, persons whose teeth are decayed or incrustated with tartar.

It is worthy of observation, that the infraction of the laws of hygiene, as habitual slovenliness, the use of bad aliments, such as cheeses, salted meats, improper nourishment and care of children, the use of badly prepared mercurial preparations, of too hard aliments, unlooked for blows on the mouth, the result of which is decayed or broken teeth, are as many causes capable of giving rise to aphthæ, or at least of favoring its development. We have even seen this disease rage in an epidemic manner, principally in hospitals destined for infants, and to attack, as if by preference, those whose constitution was the most feeble or most diseased.

As the dentist is so often consulted concerning the disease, the history of which we are tracing, although, in many cases, it extends to the organs which form his special domain, he ought to know that the treatment which belongs to it is deduced principally from the knowledge of the causes which produce it. Thus, in discreet aphthæ, it is necessary to withdraw the patient from the morbid influence in the midst of which the eruption is developed, in order that it may disappear of itself; softening gargles, a little acidulated, emollient drinks are the only remedies employed for adults; the milk of a good nurse and cleanliness are the best remedies for infants.

If, on the contrary, aphthæ is confluent, it will be advisable

to touch the diseased part with a small lancet, steeped in a fluid sharpened by sulphuric or hydro-chloric acid. On the neck of the patient we should apply warm cataplasms; we should give him for drink, at first acidulated barley, afterwards a decoction of quinquina. We should then seek to diminish the progress of the disease by revulsives, as a blister on the neck or arms, foot baths, sinapisms. If the swelling of the throat was such that, as at the beginning, the respiration was constrained and the swallowing difficult, it would be prudent to apply, about the neck, but particularly beneath the mastoid apophysis, leeches, the number of which should be proportioned to the age of the person, or the intensity of the disease.

We should insist, in the second period, upon gargles made with common water, the honey of roses, and a few drops of sulphuric acid. We should seek to calm the pain, by edulcorating the drinks with the syrup of white poppy, or any other opiate; we should follow the applications by tonic washes and gelatinous baths. But it is sometimes prudent, in these cases, to lighten his responsibility by seeking the advice of a physician, after being well assured that the disease is not occasioned by caries, or by the presence of any asperities that might be found necessary to remove.

Phlegmasia or Abscess of the Gums, (Parulis.)—When the inflammation of the gums has been carried to a certain point, it is not rare that it terminates by suppuration. There is then formed, in the tissue of the abscess, true phlegmasia, which we designate under the name of *parulis*, and which, in certain circumstances, assume a very serious character.

These inflammatory tumors may be occasioned by decay of the tooth or maxillary bones, by phlegmasia of the alveolar periosteum, by irritation of the dental nerve, by contusions, compressions, accumulation of tartar upon the gums, the presence of an artificial piece in the mouth, and a bad plug; finally, they result sometimes from that which we call a constitutional affection, from rheumatism or from metastasis; we meet with them, sometimes, without being able to assign any positive cause to them.

These abscesses, in general small and confined to the gum itself, appear, by preference, in the neighborhood of decayed

teeth, more commonly near the anterior and small molars than the large ones, and oftener in the superior than in the inferior jaw. Sometimes they constitute a pustule, and are developed in twenty-four hours, and even in less time; sometimes, on the contrary, they form vast deposits, which affect the whole jaw on the diseased side, and progress so slowly that they do not suppurate at the expiration of a month, or six weeks, and even longer.

In the commencement of the gummy phlegmasia, the patient experiences burning and a painful tension in the diseased part, which, from a vermilion red, becomes livid in proportion as the tumor increases in size; soon there appears in the centre a small white point, which opens of itself, if it is not opened, and from whence flows a greater or less quantity of pus; as soon as this liquid has escaped, the small opening closes, and the inflammation which affected a portion of the gum disappeared. It often happens that this small abscess forms for itself an issue, not very far distant from the suppuration, and it is necessary to expel the pus. This kind of tumor seldom terminates by resolution.

When a great portion of the gum is inflamed, the corresponding jaw participates in the swelling; the heat is burning; and extreme sensibility is now developed, which increases by touching it, or by the least movement of the jaw. Sometimes it increases continually, the phlegmasia increases in violence, and affects the whole economy; from thence follows a general fever, headaches, chills, inability to sleep, ptyalism, difficulty of opening the mouth, and of talking; together with symptoms which increase by degrees until the abscess opens; this generally takes place in the interior of the mouth, and is effected in eight or ten days.

When the disease is not very intense, we confine our remedies to topical emollients, small revulsive blood-lettings, or even to applying one or two leeches upon the gum; but we should not forget that leeches increase sometimes congestion, by the irritation of their pricks, and by favoring suppuration instead of preventing it; furthermore, we should only apply them around the inflamed tissue. We add to these different means, softening gargles, and, in some cases, fomentations, with water slightly

adulterated with spirituous liquor. We are sometimes so happy, by these means, to obtain a complete resolution before the pus has formed. But suppuration cannot be avoided; it would be irrational to confine ourselves to local remedies, for the treatment of which, it is necessary, in following the directions of Delamotte, to open the abscess, and make it too soon rather than too late; by temporizing, we risk the suppuration extending to neighboring parts, principally to the jaws; and we are compelled to believe that the pus opens for itself a route from without, and causes a denudation of the bones, or of fistulas which can with difficulty be cured.

If the abscess appears to follow this course, it is necessary to open it largely, in the cavity of the mouth; in other cases, a simple incision would suffice. But, whatever may be the manner of opening which we think proper to employ, the surgeon should always incline the head of the patient forward, without which he will swallow the pus, which is very disagreeable, and also very injurious.

As to the best means for preventing the formation and return of the abscesses of the gums, which depend upon the caries of the teeth, it is necessary to extract the diseased tooth; when they depend upon the presence of the pivot of an artificial tooth, it is prevented by its extraction, and principally by that of the root which supports it; sometimes, from an abscess which is opened into the mouth, a fistula remains in the gums, maintained as by the dental caries; the extraction is nearly always the only means of remedying it.

Suppuration of the Gums, (Interalveolo-dental Pyorrhœa.)—After having treated of the different phlegmasia of the gums, and of their abscesses, it might appear scarcely physiological to treat of their suppuration in another article. But when we have defined that which we understand by *suppuration of the gums*, the necessity of this arrangement will be perceived; we do not pretend, in effect, to speak here of this suppuration, which is one of the results so common from inflammation having affected the tissue of the gums: we now shall treat of phlegmasia. The affection that we shall describe consists in a *purulent dropping, which results from a morbid secretion of the gummy alveolous membrane*.

This disease has, for a long time, been confounded by authors with scorbutical diseases of the gums; it is only in latter times that its nature has been known and properly described. It affects all periods of life, but particularly persons from thirty-five to fifty years. It is common upon individuals who are large and plethoric, who eat much; it attacks both sexes, although it appears to us to give the preference to women, especially at the time when their menses cease to appear.

Among the causes which may occasion this purulent flowing of the gums, it is necessary to reckon habitual uncleanliness of the mouth, the accumulation of tartar around the teeth, inhabiting of unhealthy humid places, bad air, and, finally, all the causes of general debilitation. In the next place, the mercurial treatment, the suppression of artificial ulcers, hæmorrhoidal fluxes, the repercussion of certain diseases of the skin, scrofulous affections, syphilis, etc.

The suppuration of the gum is effected only by degrees. Confined, at first, to certain teeth, it is not until after the expiration of a certain length of time that it affects, one after the other, all the rest. The incisor and the canines of the inferior jaw are ordinarily the first attacked. Afterwards, it affects the corresponding ones, and finally the molars. This affection often presents, in its beginning, no appreciable symptom which might reveal its existence. We could discover nothing by the simple inspection of the gums, the patient did not even experience any pain. Only by pressing this membrane towards the free edge, we may perceive, between it and the teeth, a certain quantity of whitish matter, slightly glutinous.

If the disease is hereditary, or if it manifests itself in young subjects, it announces by causing an indolent swelling of the gums, which are soft, livid, fungous, and causes a dull sensation and a pain scarcely sensible; afterwards, though the suppuration manifests itself, the teeth loosen and become painful to the touch. Nevertheless, the teeth preserve their solidity whilst the inflammation does not extend to any depth in their alveoli, and the gums do not lose until late their normal color. The patients complain only of a troublesome local feeling, and of a dryness to which they give little attention. Then, as we have

said, if, at this time, we press the superior gum from above downwards, and the inferior ones from below upwards, we perceive a white matter runs out, which is inodorous, not thick, and which is soon reproduced.

One remarkable particularity is, that this fluid accumulates at first only upon the external face of the gums ; it is only at a more advanced stage of the disease that it has place equally upon all points of this tissue which surrounds the necks of the teeth. In the meantime, the disease making progress, those teeth which until then had no cause of pain, acquire sensibility, mobility and lengthen a little ; they become *soft*, to use the expression which the patient employs to express the sensation that he experiences, when the opposite teeth come in contact. The purulent matter becomes more and more abundant ; the mouth exhales a fetid odor ; the gums, if they have not already undergone any apparent change, tumefy around the neck of the tooth, principally upon the external face, and are of a violet red.

Whilst these symptoms manifest themselves upon the gums, phenomena no less remarkable are taking place upon the roots. Their external membrane furnishes, incessantly, a purulent fluid, which escapes between them and the walls of their alveoli. By degrees, this latter, yielding to this morbid influence, wears away, and finally disappears, in proportion as the inflammatory phenomena of the external membrane become more intense. But, for the same reason that we have seen that the labial portion of the gums is the first affected, for the same also the external layer of the alveolus is the first absorbed. A contraction of the gums results, the gums coming in contact with the roots and abandoning the necks of the teeth. At times, the disease arrives at this crisis, the teeth are late falling, and when this happens, if we examine the surface of the roots, we will find there something of a milkish white, and scattered with purulent striæ.

Such is the course of this disease. We do not know precisely its duration ; for it extends, in certain instances, to the entire loss of the teeth, that it takes six, ten, and even fifteen years to destroy. It has, nevertheless, a rapid progress, and it

is not rare that it suddenly ceases to progress, and even that the purulent dropping, which takes place under the gums, ceases without any aid of art; the teeth continue to be movable and elongated; but this is often only many years after the disease commences.

As most of the local affections that we have spoken of disappear after the extraction of the tooth around which the dropping takes place, we naturally regard the teeth as the first cause of all these disorders. Fauchard and Jourdain have at least established the conclusion, that the disease may be regarded as purely local: according to them, all the affections that we have described are only the inevitable result of the development of the efforts that nature makes in order to cause the expulsion of organs that it has affected even in their vitality.

If this reasoning is sometimes conformed to the truth, yet we cannot deny that, in the greatest number of cases at least, this disease affects not the general constitution of the subject, but principally the changes which follow in the exercise of different functions at certain ages of life. According to some authors, the dropping of the purulent matter ought principally to be regarded as a salutary secretion, capable of preventing the development or suspending the course of serious affections; this seems to be the most probable opinion.

Bourdet, who considers this affection as purely local, proposes, in order to remove it, to destroy the ulceration, at a point beyond the suppuration, with a flat and small cautery, strongly heated, that he places as far as possible between the gum and root, even to the depth of the space resulting from the destruction of the alveolar ridge, having care to burn, two or three times, the whole internal face of the gum. If, eight or ten days after, we press the edge of the gums, and there still flows a little matter from it, we cauterize, according to him, a second or third time. Finally, when, in spite of these cauterizations, the flowing continues, he advises to destroy, with the scissors, by two incisions, which unite to the right angle of the side of the point of the root, all the part of the gum deprived of its alveolus. Toyrac, who doubtless had never read Bourdet, proposes exactly the same means as he gives, as the result of his own experience.

Cauterization is, unfortunately, far from being as constantly followed by success as Bourdet believes. Jourdain, who has had occasion of seeing equally as many persons affected with this disease, asserts that he has never cured a *single person* by the use of this means. Let us admit, then, although it will not be a fact altogether demonstrated, that this purulent state of the gums is the result of dental caries, or a change of the alveolar partitions, we might be liable to see all local treatment fail, at least if the disease is recent, and the subject does not enjoy good health.

To change the general constitution the efforts of art should aim; it possesses, in this respect, means whose general therapeutical action might produce advantageous results. Let us take notice, at the same time, that if the suppuration is abundant, and when it exists many years, it is always advantageous, in the course of general treatment, to establish an artificial ulcer, and to prescribe the use of purgatives, at intervals sufficiently near to avoid the brisk succession of the flowing of the purulent matter.

Dental Fistules.—As we have already seen that decayed teeth decay often at their roots. A suppuration results from it, in the alveolus, always accompanied by a painful swelling in the gums. Here, as Fox justly remarks, the laws which determine the flowing of pus are the same as those which we observe in abscesses in general. The suppuration is established in some part of the surface of the root, and forms an opening in the place most favorable to its flowing. The periosteum which covers the root where the deposit is formed, tumefies, and sometimes attaches itself. The pus collects, then, as in a sack, which, in swelling, produces a considerable pressure upon the walls of the alveolus, whose anterior edges are partly absorbed before those which are found within the mouth. The progress of ulceration continues until the gum itself becomes pierced through that part which corresponds to the extremity of the root, and the flowing of pus made by this opening, whose edges generally swell, has the appearance of a small red fungus. Sometimes, after the discharge of pus, the inflammation ceases; but the ulcer rarely closes, and a small crooked opening remains, which constitutes what we call a *dental fistule*.

Some authors confound this affection with the fistulous ulcers of the gums. Maury places himself amongst these, by saying, that it often happens that, after the opening of the abscesses of the gums, not having been brought under the influence of the remedy, in spite of the general means employed, forms the general fistules of moderns. In that, both commit an error; for fistulous ulcers of the gums differ from dental fistules in this, that the first are only openings of the abscesses belonging to the gums, whatever may be the cause that prevents it from closing, whilst the second have their first cause in the alveolus, and affect but passively that part of the gum by which they are surrounded.

The dental fistules are then generally occasioned by the decay of a tooth or maxillary bone, or even by the parts of a tooth or alveolus, which, not having been affected by the suppuration are situated under the gums or engaged in their tissue. Sometimes, the ulcer presents only a small orifice, often obstructed by the presence of a watery ichor, which flows from it, and dries when it comes in contact with the eye. Sometimes we perceive two or three of these openings instead of one, and they are generally near each other. A stylet introduced into one of them, we perceive that the bone is denuded and movable, or that the diseased tooth is insensible but vacillating. That which we have said of the causes and formation of dental fistules, prevents us from saying much on their treatment; it is always necessary to extract a portion of the decayed tooth which injures it, or to attempt, by employing the best means, the exfoliation of the affected bone, if it is the alveolus which is diseased. This is not only applicable to the case where the fistule opens in the mouth, but it is the only one which should serve as a guide when it extends across the thickness of the jaw or above the cheek bone, if the cause of the abscess is in the superior jaw; or near the angle of the inferior jaw, or the edge of its base, if the cause of the disease is in the inferior jaw.

These dental fistules, affecting the face, are also very common; we have seen many persons, amongst others our friend Dr. G., affected with one a long time, and waited in vain for many years, in the hopes that it would cure of itself. Near the

issue by which the separation was affected, the skin was wrinkled, and had a spongy appearance ; its tissue was red and soft. After the extraction of the tooth, the flowing of the pus diminishes gradually ; the exterior opening closes ; but, as the ulceration has destroyed a part of the cellular interstices and teguments, the skin contracts and heals, and, in the place occupied by the fistulous ulcer, a hollow or deep cicatrix, which we sometimes suppose as the result of a scrofulous affection ; a defect which should be remedied by the application of appropriate means, and which we render always less irregular, by accelerating, as soon as the abscess forms, the flowing of pus, by an incision made with the point of a lancet.

As the three affections which we have described under the name of *abscesses*, of *suppuration of the gums*, and of *dental fistules*, have characters common with the purulous or mucous collections of the *maxillary sinus* or *antrum of highmoria*, and that, on the other hand, the treatment of these collections, although belonging to general surgery, demands, very often, the intervention of the dentist, we believe a separate article should be devoted to it.

Abscess and Dropsy of the Maxillary Sinus.

The maxillary sinuses, of which we have designedly given a very brief description in our anatomical part, as it has but an indirect connection with our subject, are, as we know, two large triangular hollow cavities, in the thickness of the maxillary bone, immediately beyond the orbital fossæ, and without the nasal fossæ, agreeing to that part of the face which forms the jaw. Lined by the mucous membrane, which is the continuation of that which covers the surface of the mouth and the nasal fossæ ; these cavities are susceptible of being filled with a true pus or a simple mucous substance ; hence their abscesses, and that which we commonly name their *dropsies*.

The purulent matter which forms the abscesses of which the maxillary sinus may be the seat, is as often the direct product of a termination by a suppuration of the inflammation of the mucous membrane which lines them ; but this inflammation

is not, most ordinarily, the cause of this abscess; they are more frequently occasioned by decayed teeth, which affect their alveoli and the walls of the maxillary sinus, by abscess of the gums, that we have described under the name of parulis, by a tubercle which developes itself, as Boyer very judiciously remarks, at the roots of the teeth which correspond to the sinus; finally, as Vidal, (of Cassis,) remarks, by an ulceration of osseous tissue itself, whose suppuration communicates with the cavity of the sinus and fills it.

Whatever may be the source from whence the purulent matter proceeds, the first indication of its accumulation in the maxillary sinus, is a dull, deep pain, which affects the jaw, and even extends from the molar teeth to the orbit. The teguments of the face near the painful spot, are not at first tumefied, do not, consequently, change their color, and it can be compressed without hurting the patient. Yet, in proportion as the purulent matter collects, the jaw swells; the walls of the sinus extends, and forms an exterior tumor above the last molars and interior side of the palate; the bone softens and yields under the pressure of the finger; the fluctuation becomes sensible; the deformity produced by the dilation of the sinus is very apparent; a yellowish, purulent matter comes from the nostrils when the patient blows his nose, or makes a strong expiration.

This liquid accumulates, having no free passage by a natural opening of the sinus,* which is too compressed and elevated or close, it softens, by its remaining and its change, the inferior walls of this cavity are destroyed by degrees; and, finally, one or more issues by the nostrils, alveolar arch, and in different parts of the face are formed, from whence fistules result, which tend to a common centre, which is the cavity of the sinus. The patient is then slightly relieved by the discharge of pus; the jaw, at first tumefied, sinks, but the fistules, formed on the side of the

* This opening, situated superiorly and anteriorly on the side of the nose, between the two cornets, nevertheless nearer the superior, did not much exceed the diameter of a pigeon feather; its form is little oblongated, and, upon many subjects, pituitary membrane forms on the side of the sinus a kind of fold, which gives to it an oblique direction, consequently, it is sometimes difficult to be perceived.

the alveoli, of the jaw, beneath the orbit, and in the nose, continue; the molar teeth are loosened, the bones are carious, and the mouth exhales an insufferably offensive odor.

As it regards the singular mucous matter which fills the maxillary sinus, and which constitutes what we call *dropsy* of this cavity; it proceeds simply from irritation of its lining membrane; an irritation which is not sufficiently great to cause inflammation, and, consequently, an accumulation of purulent matter, but which is sufficient to induce a more abundant secretion of mucous fluid which it constantly secretes. The only sign which distinguishes this mucous secretion from purulent collections is, that they never proceed from inflammatory symptoms, which always attend the development of the latter, and that they more frequently affect young subjects, since, of three cases which Boyer describes, the oldest was not twenty years, and the most remarkable case on record, and of which Dubois has given the details to the Professors of the School of the Ancient Society, and upon the disease had commenced at the age of seven years and some months. As this case sums up, at once, both the diagnostic and therapeutic indications of this disease, we shall here give a detailed description of it.

A child of seven years had a small hard tumor, as large as a walnut, at the base of the apophysis rising from the superior maxillary bone of the left side, neither growing nor producing pain. The parents paid no attention to it then; but when the child had reached his sixteenth year, the tumor commenced to grow and become painful. Before he had arrived to his eighteenth year, the tumor had acquired such volume that it covered the edge of the orbit. The eye was forced backwards, the eyelids were closed; the roof of the palate towards the mouth was projected out, the corresponding nostril was stopped up; towards the jaw was a considerable tumor, whilst the nose was forced back from the opposite side; finally, the skin which, from the beginning of the tumor, continued with the inferior eyelid, was tender and red, and threatened to be broken; the upper lip was drawn upwards, thus permitting us to see the gums, which were much more prominent than those of the opposite side, and it was only from this point that we were able to

see the diminished size of the bony walls of the sinus. The patient spoke, chewed and swallowed only with difficulty.

Pelletan, Sabatier, Boyer and Dubois, agreeing upon this subject, thought that a fungus of the maxillary sinus existed, which ought to be removed. Dubois, preparing to make the operation, perceived that there was a manifest fluctuation to the level of the gums; this circumstance caused him to abandon the idea of a fungus, but he expected, before deciding, by making a slight opening, that the flowing of a viscous liquid would reveal to them the true nature of the disease. He then made an incision upon the alveolar bone, from whence soon flowed a liquid which resembled that which flows from the *grenouilletée*. He then introduced into the opening a probe, by the aid of which he perceived that the cavity had a great analogy to the anterior volume of the tumor; and by directing the probe with discretion, in order to assure himself that there was no fungus there, he perceived a hard body, which appeared to be an incisor tooth, and was very near the opening.

Five days after the operation, Dubois extracted the two incisors and a molar, and elevated, at the same time, a corresponding portion of the maxillary bone. As he caused an abundant hæmorrhage, he was obliged to fill the wound with lint; but it ceased some days after, and Dubois was able to examine, with ease, the interior of the cavity; he saw, on the superior portion, a white spot, which he supposed, at first, to be pus; but upon touching it with a probe, he saw that it was a tooth, which he extracted.

The remaining portion of the treatment consisted merely in making injections, and in applying the ordinary preparations. At the expiration of six weeks the cavity disappeared; but the tumefaction of the jaw, palate, and the displacement of the nose remained. Nevertheless, after a year and a half, no kind of trace of it remained; the patient had been entirely cured.

But, although matter, either purulent or simply mucous, had accidentally accumulated in the maxillary sinus; in a word, although there was an abscess or dropsy there, the essential point to accomplish was, to free the cavity of its contents. Jourdain has proposed, in order to accomplish this, to introduce into the

natural opening detersive injections, by means of a crooked tube introduced through the nostrils; but reason and experience have demonstrated that this operation, a true catheterism, was infinitely more difficult and much less efficacious than we might think; consequently it was abandoned. It is, at the present day, received and adopted in principle, although it cannot cure an abscess or dropsy of the maxillary sinus, or destroy the decay and fistules which are the consequence; yet we can employ, in order to form an artificial opening, for the flowing of the accumulated matter.

Many methods have been prescribed for the accomplishment of this; but that which is preferable to all, and which we give Meibonius the credit for, although it was employed by other practitioners after him, is that which consists in extracting the superior molar teeth upon the diseased side, then to perforate the alveolus, and to penetrate the cavity as far as the sinus, in order to clean it, so that we can make, by this artificial opening, detersive injections.

As a general rule, we should always prefer to extract those molar teeth which are decayed, loose, yellowish or painful, whether they may or may not be the cause of the disease. If many are decayed, we should extract them; and, in this case, there is ordinarily a decay of the alveolus and fistule of the gum; that which renders the disease very apparent, and the extraction of all the decayed teeth absolutely necessary. When all are healthy, we should always prefer to extract the first or second large molar, not only because they are more easily dispensed with than the anterior teeth, but because they correspond to the middle part of the declivity of the sinus.

Boyer recommends the isolation of the neighboring parts, by four incisions forming a square, the gums covering the portion of the alveolar border should be penetrated, in order that they, being deprived of all communication with the rest of the gums, may be elevated without causing the patient to suffer. This precaution seems to us to be only useful in the case where the former loss of the teeth, towards the point where we wish to perforate, has already permitted the alveoli to unite, and the gums to cover them.

As it regards the perforation of the alveolus, different methods have been recommended ; some practitioners employ a simple stylet, Desault employs a perforating trepan, Richter a trocar. When we have been called upon to perform this operation, we employ, with great success, a triangular, pointed and sharp instrument, as the trocar, mounted upon a round handle. We use this instrument in perforating the deepest roots, by turning it between the fingers, in order to penetrate the root. When the resistance ceases and the flowing of matter commences, the end is accomplished. As we are compelled to commence the opening at a certain time, in order that it may be sufficiently large, we advise it to be filled with a plug of wood, in order that we may empty the sinus in time, or with a tube. The first method is preferable, because it prevents particles of food and air from entering it.

This method of emptying the maxillary sinus is, doubtless, the most sure and reasonable, and, fortunately, that which is most frequently employed. But the disease does not always take the course we have mentioned : "The humor may be of different consistency ; it may be in a different part of the cavity, or be shut up between its walls ; and besides, it does not form a scarcely considerable collection in a cavity, without the disposition of the parts is modified ; the declining point may vary. It is this fact which explains the success obtained by different proceedings, and gives a real importance to each one of them."

Lamorier opens the sinus between the zygomatic apophysis and the third molar tooth. Desault accomplishes it by the fossal canine ; upon this side, the wall is thinner, easier of access, and the undertaking less difficult ; it is necessary only to remark, that if we see proper to employ the procedure, we must be careful to operate, as before, by an incision made in the jaw, but simply to raise from above the labial angle, in order to discover the gum, to make an incision of a centimetre or two in length, in such a manner as to denude the bone before perforating it ; afterwards we place a band of linen in the opening.

If a tumor arises in the side of the mouth, and particularly if it fluctuates towards the roof of the palate, we should, according to the advice of modern surgeons, imitate Cheseldon, who per-

forates the sinus from this side. If there should already be a fistulous opening here, it may only be necessary to enlarge it, as is demonstrated by the following case :

In 1841, a youth, aged sixteen, named J. An. Fuillant, by trade a locksmith, entered the charity hospital under the direction of M. Gerdy, (Saint-Jean Rall, No. 13.) He had, upon the anterior wall of the first bicuspid, a fistula, from which flowed a large quantity of pus. M. Gerdy, having convinced himself that this came from the maxillary sinus, enlarged the fistula already existing, so as to encroach upon the anterior and internal walls of the sinus. As the result of this perforation, the canine tooth became loose, but by degrees it recovered as much stability as the teeth on the other side. The opening made into the sinus was large enough to admit a roll of cotton as large as the little finger. The progressive development of the sinus had caused the inward deviation of the four superior incisors and the left canine tooth, which had this movement.

Finally, when pus flows from the jaw and the orbit, it is easy to perceive that the fistula through which it discharged cannot be healed, except by perforating the alveolar border at the most dependant part. All operations, therefore, upon the fistula is useless, the cause being inflammation of the sinus, accumulation of matter in it, suppuration, with or without caries or necrosis. The treatment of these superior fistulas is the same as that of urinary fistules ; to wit : to change the course of the fluid from the opening through which it has been accidentally discharged. Then some emollient applications will promptly obliterate the fistula. We shall not here speak of the treatment of the disease of the sinus, nor of caries and necrosis of its walls. That which belongs to our immediate speciality, is the opening of the sinus ; for if this disease is induced, for example, by the presence of a foreign body, the development of a polypus, the presence of worms, as we have seen, the cure depends upon the removal of the one, and the destruction of the other.

Adhesion of the Gums to the Jaws and Lips.

Whatever may be the nature of the inflammation of which the gums are the seat, whether direct or consecutive, that is to say, belonging to their tissue or dependant upon changes of the osseous parts which they cover, it causes a swelling, that unites them to the walls of the mouth, in such a manner as to occasion, under certain circumstances, an adhesion between them and the jaws. This adhesion, which we have said might sometimes result from a congenital vice, generally begins at the moment when the inflammation of the gums terminates in suppuration, or rather, when this last assumes the character of an ulcer. Sometimes it is partial, sometimes it occupies the whole extent of the internal side of the gum, and sometimes both sides at the same time.

When the causes of this adhesion present themselves, no means should be neglected in order to remove them; for, whatever may be its extent, it always interrupts the functions of the mouth. We nearly always succeed in preventing it in persons affected with maxillary fluxions, by mucilaginous gargles, and by frequently passing between the jaws and the gums some analogous liquid, as a decoction of the root of althæ, etc.

If, for want of precautions, or in spite of precautions, we cannot prevent the adherence, it is necessary to take advantage, in order to destroy it. At the time when it appears, a finger may suffice to prevent it; but if it is of long standing, it will be necessary to have recourse to the bistoury. The separation being made, we should seek to keep the parts separated, in such a manner that it would be entirely impossible to unite them. In order to accomplish this, we should place in the wound a piece of cotton or of lint, steeped, as we have already said, in some mucilaginous liquid.

Finally, if the adherence is complicated of a fistula bordering upon the exterior, but proceeding from a dental or alveolar caries, in order to treat this affection the adherence must be destroyed; the extraction of the teeth should not take place till afterwards; otherwise, this operation might occasion a tearing of the jaw, which follows a sharp pain or an inquiet hæmorrhage.

This was the case with Dr. G——, of whom we have spoken whilst treating of dental fistula.

If the jaws may, in consequence of some inflammation, contract an adherence with the gums, they may, for the same reason, contract one with the lips; only this adherence is more rare, because the excessive mobility of the lips opposes it much more than the jaws, and these latter, being thicker, and better provided with cellular and vascular tissue, are in a more favorable condition to unite, under some circumstances, with the parts with which they come in contact.

Whatever may be the cause of this adherence, it is certain that it is sometimes the result of an operation in the mouth, as the extraction of a tooth when the lips were inflamed; but it is seen oftener among persons whose lips and corresponding gums are the seat of an ulcerous affection, for example, and principally of syphilitic ulcers. A burn may, without doubt, occasion it.

The most curious example that we have met with of this adherence, is that of a young man, of eighteen years of age, who had his upper lip united to the gum surrounding the four incisors, in consequence of a venereal ulcer. This adherence was such, that the lip was retracted, and formed, below the lip, a thick loop, which allowed us to perceive the six anterior teeth, which had commenced to jut out very disagreeably. All that was required was to cut this loop, in order that the lip might be depressed, and the teeth return, according to the physiological law that we have established, (in another part of the work,) to the vertical line to which they belong. Our conduct, in this instance, marks out the course to be pursued in similar occurrences.

As to the union of the lips, it may be complete or incomplete: the first, as congenital defect of conformation seems so rare, although Berad speaks of it, that Boyer himself makes no mention of it; and as to consecutive accidents, we know of but one instance, that is related by Turner, of a miller, who having had his lips excoriated, they united together, in such a manner, that a slight opening, which permitted him to have his food introduced through a tube, finally disappeared, and he died of hun-

ger. In all such circumstances, the rational indication is so easy to be established, that it suffices to mention it; it is the division of the cicatrix.

Constitutional Affections of the Gums.

The diseases of the gums that we have described heretofore, have, as a common characteristic, a nature primitively inflammatory, and generally dependant upon a local cause. But these are not the only ones to which they are subject; they may, besides, take an active part in certain affections which attack their entire constitution, and offer, in this case, symptoms, of which the study belongs, before all, to general pathology, since it yields only to the treatment of constitutional affections; but the dentist ought to know perfectly well, if only to distinguish them from local diseases, and not to apply any treatment without the rules of general therapeutics.

The essential affections of the gums may be divided into scorbutic, scrofulous, syphilitic or mercurial nature. We will examine, successively, all four in a summary manner.

Scorbutic Affections of the Gums.—In the actual state of science, it is difficult to give an idea of the intimate nature of scurvy. This disease consists, as the adepts of the physiological school have lately maintained, in a chronic irritation of the sanguinous capillaries; the solidists, of the school of Pinel, think it is owing to the atony of the red vessels; and the humorists, who are our partisans, believe it is owing to a defect of the blood; still, it is no less true, that the gums are nearly always affected first.

The changes which these parts experience, from the simple tumefaction and bleeding, even to their complete disorganization, are infinite. The patient at first experiences a disagreeable sensation, a kind of unpleasant itching. Soon the gums become swollen, take a red color, and bleed from the slightest touch. They remain sometimes in this state; but, most ordinarily, the disease progresses; then, from being tumefied, they become fungous, of a livid red, and exhale a fetid odor; soon, they acquire a considerable size, are the seat of a deep ulceration, which, in certain cases, envelopes the dental arch.

At this stage of the disease, hæmorrhages are very frequent, the teeth become loosened in their sockets, and finally drop out. It is rare that their color is not much changed; this becomes blackish or brownish. From the gum, the disease not only affects the teeth, but even causes a caries of the maxillary bone, which is sometimes very great. In consequence of this disorganization, the dental nerve is liable to be exposed, and this circumstance may become the cause of violent pain.

The gums sometimes take a color so deep that we believe them affected with gangrene. At other times, they become covered with fungous excrescences, which often acquire an enormous size. These excrescences vary in color, form and consistency. Sometimes they are of a livid red, and represent tubercles with a large base, or a straight pendant, but of a firm texture; sometimes, on the contrary, they are of an ash-grey, resembling tattered rags, and are flabby and bloody; this is their habitual character.

It is difficult to confound scorbutic affections of the gums with any other changes that we have described. But all symptoms disappear, when, to local symptoms are added pathognomic signs of the disease, which are vague pains in the limbs, and a spontaneous lassitude, and an habitual sadness, a swollen face, particularly of the inferior eyelids, a general tumefaction of the skin, and the appearance upon the limbs, of a purple, bluish or vivid red color, sometimes yellowish at their circumference.

In order to remedy scorbutic changes of the gums, we should not pursue any chimerical action. It is only upon the use of proper means that we can relieve the economy from this state of general debilitation, a true anæmia into which it is so often plunged—means, at the head of which we find the powerful resources of hygiene, which should be the basis of all rational treatment. Nevertheless, from the time when the gums are tumefied, spongy, or when the teeth commence to vacillate, but before any ulcers exist, we should endeavor to arrest the progress of disorganization, by the frequent use of gargles, acidified with the sulphate of alumine or sulphuric acid, the first in doses of one drachm, with a quart of a decoction of barley and red roses,

the second with one-half drachm only with two quarts. These tonic astringents are applicable when the bleeding is considerable. We have also prescribed spoon-wort as a specific in this case.

But if the gums are already ulcerated, we may use, with advantage, gargles made with barley water, honey of roses, and hydro-chloric acid, in this proportion: acid, one and a half drachms; honey, one ounce; the decoction, one pint. The excrescences themselves often disappear under the influence of this treatment; but, if they do not, the bistoury must be resorted to. Finally, in the odontalgic case resulting from the denudation of the dental nerve, it would be advisable to fill the cavity of the diseased tooth with cotton, moistened with a narcotic tincture. This precaution should be observed, as we might not be able to plug the tooth without aggravating the pain, or extract it without running the risk of a hæmorrhage difficult to stop, and always more dangerous as the subject is more weak.

Scrofulous Affections of the Gums.—When we examine the gums of scrofulous individuals, we find that they are generally pale and soft, sometimes even swollen, and covered with ulcers. These ulcers issue a semi-purulent, whitish, nauseating matter, and often loosen the teeth, which they separate from the gums, and finally cause them to drop out. This state might be as well confounded with the disease which we have described under the name of suppuration of the gums, if the discoloration and continual swelling of the skin, the constant issues, the choking of the sub-maxillary, lymphatic and abdominal ganglions, the inflation of the belly, the tumefaction of the articular tissue, did not denote its true character.

When it is plain that this morbid state of the gums proceeds from scrofulous cachexy, the only means that can remove it is, to apply the treatment belonging to this cachexy; we can only aid it by the use of lotions, gargles made with a decoction of red roses and of bark of oak, of quinine, or of simple water mixed with some spirituous liquor. We have also prescribed lotions with liquids containing the iodurated potassium, commended lately as a powerful anti-scrofulous.

But we should always be very cautious in the administration of such powerful substances; it would be better to the means that we have enumerated, and to which we might add frictions made upon the gums, with powders formed of a mixture of magnesia and sulphate of quinine, or of any other tonic astringent substance. It is almost useless to say that it is indispensable to prescribe the use of succulent animal nourishment, of wines generally, the inhabiting of dry and well aired places, exercise and insolation.

Syphilitic Affections of the Gums.—The symptoms of the venereal disease which appear upon the gums, are ordinarily of an ulcerous nature. These ulcerations, for the same reason which all have that appear upon the gums, are not as easily distinguished as it is commonly said and generally believed. Nevertheless, their pointed shape, their greyish bases, and their tendency nearly always to enlarge, are indications which point out their true character, and which can easily prevent us from confounding them with aphthæ or any similar affection of which we have heretofore spoken.

The treatment of these ulcers does not differ from that which belongs to the other symptoms of which it is the consequence. However, if they were first and very recent, we can not only arrest them at once, but even cure them altogether, by touching them lightly, as far as a perfect cicatrization, with a pencil of nitrate of silver, (infernæ stone,) experience having proven to Ricord,* Ratier and Desruelles, that syphilis soon becomes constitutional, that is to say, inveterate, as we have believed.

Mercurial Affections of the Gums, (Mercurial Stomatitis.)—Persons who have used mercury as an internal or external medicine, men employed in mines of this metal, or those who, by profession, habitually employ it, as the workmen in glass manufactories and gilders, are exposed to a particular kind of disease, which at first affects the gums.

The result of this disease are more or less deep excoriations. When, then, they are about to form, the gums are at first very hot, then they become engorged, and are of a smooth white, de-

* RICORD: *Practical Treatise upon Venereal Disease.*

pressed around the crowns of the teeth, and the rest of the gum assumes a violet color. We sometimes observe, upon the gum, mucous projections, a kind of cicatrix. All these parts are very painful when subjected to the slightest impression. The inward part of the throat is, moreover, red and phlogistic, the sub-maxillary ganglions are engorged; the patient experiences great difficulty in swallowing, talking and spitting; the slightest movement of the jaws causes violent pain; finally, a thick and ropy saliva flows in abundance from the mouth, and unlooked for gripings take place, which are only the preludes to an intense diarrhœa.

Soon, a kind of small pustules manifest themselves, which are converted into abscesses, and leave, near their gaps, ulcers, which extend as much more in size and in depth, as their cicatrization was of long or short continuance, that is to say, as the cause which produced them was greater and of longer duration. They differ from aphthæ in this respect, the latter are more superficial, and of a white color. They are also, in general, more numerous than those which result from syphilitic virus, and are not, as those, cut off at the top, although their bases are as grey, and sometimes even bloody, as scorbutic ulcers.

In this affection, the congestion of the gums is, in general, proportioned to the quantity of mercury which is found absorbed in it. If this quantity is considerable, the ulcers are very numerous; often they are not even confined to the gums, for they occupy, as frequently, the sides of the tongue and the whole extent of the mucous membrane which lines the mouth. The teeth then become blackish and loosened, and the breath acquires an insupportable odor.

The circumspection with which we daily administer mercury in France, has much diminished the frequency and intensity of the accidents which result from its employment; and the general adoption, in the work-shops where the metal is employed, of certain precautions of which we have spoken in the chapter on hygiene, has preserved the workmen from many accidents.*

* It would be desirable that the new mode of gilding should generally be adopted, that is, by the means of galvanism, which excludes the use of mercury: the health of the workmen would be thereby much improved.

But when these accidents do occur, it is necessary to withdraw the workmen from its action, and to keep the patient from its employment. We then prescribe softening gargles, made with barley, the roots of althæa, flaxseed, honied milk, slightly adulterated with the syrup of white poppy. If the salivation is too abundant, we should seek to restrain it, by applying cold bodies, but principally by compresses, steeped in vinegar water, upon the jaws and the corresponding regions of the salivary glands.

But, of all the means, that which experience demonstrates to be the most efficacious, consists in frictions, repeated frequently during the day, with the powder of muriate of dry chalk, and gargles rendered astringent and tonic by the syrup of caechu, and even the alcoholic tincture of ratanhia, or any aromatic spirituous liquor; seconded, finally, by foot-baths, and revulsive purgatives, if the inflammation has not gained the intestinal tube, and if there is no diarrhœa.

An honorable professor of the faculty, Chomel, believes vapor baths an efficacious remedy for *mercurial stomatitis*. He was led to the use of this means by the following circumstance, which he thus relates :*

"After being about twenty-five years physician to the *Charity*, we received into our service a poor woman, covered with eruptions; we prescribed the use of mercurial frictions, in consequence of which she experienced all the ill effects which habitually result from the use of mercury. We then ordered a vapor bath, (not expecting to obtain the result for which the frictions were intended;) the buccal affection disappeared as by enchantment. The success of this attempt gave us some hopes upon the efficacy of this means; we have employed them many times in similar instances; but, although it has often contributed efficaciously to the cure of the patient, it has not, in every case, answered our purpose."

This able practitioner has, very recently, however, employed, very advantageously, vapor baths upon a female admitted in his service, at the *Hotel Dieu*, for mercurial stomatitis, proceeding

*Gazette of the Hospitals.

from working in gilding brass, and with whom a violent diarrhœa contra-indicated, evidently, the use of purgatives. This patient had symptoms of the affection carried to the highest degree; she nevertheless departed from the hospital perfectly cured, after only seventeen days of treatment. We then recommend to practitioners vapor baths, if not at the commencement of the disease, at least at the time when the dryness of the skin announces that it is tending to the intestinal tube. We have recommended them, not long since, with much success, to a young commission merchant, who, in order to free himself from a syphilitic affection, had irrationally used mercurial frictions, and with whom, to the worst of the preceding enumerated symptoms, was added a trembling of the limbs.

Gangrene and Sphacelus of the Gums.

Most of the authors who have written upon the diseases of the mouth, have treated of gangrene and of the sphacelas of the gums in a distinct part. But the actual state of pathology, principally anatomical pathology, does not permit, according to our opinion, to make this distinction; *gangrene* being, to speak correctly, excepting in cases when it proceeds from the action of a violent compression, only one of the modes of the termination of the inflammatory diseases that we have described, carried to the highest degree of intensity; and *sphacelus*, the result of one of the constitutional affections of which we shall treat, and whose effects will be particularly centred upon the gums.

Whatever may be the cause of the two affections in contemplation, independent of the commemorative signs which belong to each one of them, the first is recognized by the bluish color, which soon becomes slaty and even black, in many points of the gum, accompanied with a horrible odor; the second, by a kind of decomposition of these parts, which become soft, livid and are reduced to a kind of putrefaction, and abandon the alveolar borders, without, however, being accompanied with an odor as unpleasant as the first, for it is more insipid and nauseous than fetid.

These two states, opposed by all the proper means for favor-

ing the termination of the different ulcerations of the gums, and for reviving their vitality, according to the case, either become drained by an over irritation, or extinguished by a deleterious cause, if we can speak thus, which affects the whole organic system at once. We have so plainly described these different means, in treating of the orders of diseases of the gums, of which they are but the last expression, that it will not be necessary to return to them here.

As to gangrene of the gums, resulting from a violent contusion, as a blow, a fall, or of a too great pressure, as that which might be the result of a badly arranged artificial plate in the mouth, it causes a sharp pain, which at first precedes it, and local signs that indicate it. It can only be cured, as we firmly believe, by destroying the cause which produced it, accompanied by the use of the means applicable to other cases of gangrene.

We, some years since, met with an example of this latter kind, in a young man, aged seventeen years, whose two central incisors of the lower jaw a dentist had endeavored to straighten, by the use of a double band, that he had badly adjusted and pressed too tightly upon the alveolar border. The pain resulting from the application of this fixture was at first very acute; but the young man, believing it inevitable, had courageously endured it. It suddenly ceased, and when we wished to judge of the effect of the treatment, we perceived, added to a cadaverous odor which exhaled from his mouth, a number of small pustules, filled with a slate-grey pus, and two blackish eschars, which covered, upon each side, the projection that the roots of the canines ordinarily caused upon the alveolar border, and that the gums were, in a great measure, gangrened upon their anterior face, being the one upon which the pressure had principally been exerted.

Tumors of the Gums.

Tumors or Fungous Epules.—We give the name of *epules* to a different kind of fleshy tumors which develop themselves upon the gums, or in the depth of the alveoli. They are excessively variable in form, nature and volume.

Some are soft, fungous, supine and have a striking analogy with the fungosities which we sometimes see formed upon the surface of atonic ulcers and of decayed bones. They are of a dark red, punctured with ease, and are filled with a purulent and fetid matter, which is sometimes bloody. They are nearly always occasioned by the decay or necrosis of a root of a tooth, or by a portion of the alveolar border. We have also known this species to be the result of the comminuted fractures of the jaw, and to be continued by some necrosed splinters of bone.

Others are of a closer, more elastic tissue, and of a more livid red ; they yield to a pressure, but instantly return to their former position when the pressure is removed ; we feel the arterial pulsations plainly there, and they are sometimes sensible to the sight. These tumors are covered by the gummy membrane, and their organization appears to be the same as that of the erectile or blood-colored tumors. Before they have had an incision, they yield no kind of matter. If we incise them, an abundance of red remillier, or of arterial blood, flows from them ; they may result from contusions, or from no known cause.

We also meet with hard, rough, pale or violet-red epules. Some of them are supine, others are the seat of a dull pain, or of more or less acute shooting pains. These latter possess the most troublesome character, and are most liable to degenerate into a cancer. They are very common : the different museums of pathological anatomy, amongst others, that of the Faculty of Medicine in Paris, possess many cases ; Fox relates a very remarkable example, in his work ; we ourselves have met with many in the course of our practice, among others, one smaller than that of which Fox speaks, but yet of considerable size.

Ambrose Paré* speaks of having seen one of these excrescences, so voluminous that "part of it appeared without the mouth, and rendered the patient a hideous object." He says he destroyed them, by first tying them with a very strong double thread, and afterwards by applying an actual cautery, in order to destroy the remaining part of the tumor. He adds, that this tumor is often cartilaginous, and that it even, in time, becomes

* Book eighth, chapter fourth.

bony. Fauchard has also given us an account of a case of this latter kind, which he was called upon to treat.

Epules are developed much oftener upon the inferior than upon the superior jaw ; they may form upon the anterior and posterior parts of the gums, or between the teeth, in the empty alveolus, or, finally, upon the internal side of one of the branches of this jaw ; of this latter kind, Begin gives us an example.* The volume of these tumors, as we have already observed, is extremely variable ; some scarcely equal a pea ; but others, as we shall quote examples, exceed a large nut, and even acquire an enormous dimension. Finally, we see epules proceeding from the gums, filling the cavity of a fractured and decayed tooth, covering it, and even binding the crown, so as to form upon its sides a thick cap, which hinders mastication, and prevents the complete occlusion of the mouth.†

Their form presents as much variety as their volume. Some are round, projecting and supported by a pedicle ; others are equally round, but supported by a large base ; others, finally, project but little, but are very extended in surface, and adhere largely to the gums, in such a manner as to be able, by a superficial examination, to be confounded with a simple swelling, generally with that which has no evident inflammatory character, as when it is the product of the action of mercury or of a scorbutic or scrofulous affection. But, in these three last cases, they are not decided tumors, which form upon the gum, or arise in the depth of the alveoli, between the teeth and the gum, or between two neighboring teeth ; they are true tumefactions of the whole of the gums, which become spongy and bloody.

We distinguish epulis from an abscess of the gums, in this way, the progress of the latter is, in general, more rapid, and follows an inflammation which takes place previous to its formation. An abscess is accompanied by a fluctuation which epulis generally is not, however soft it may be. It is not possible to confound this disease of which we are now treating with the

* Work quoted, vol. 1st, p. 236.

† Dictionary of Medicine, article Epulis.

sarcoma of the maxillary bone, because epulis is not accompanied by the swelling of this bone, and we cannot introduce, by the pedicle of the tumor which it forms, a stylet, as far as the maxillary sinus, as this is the case when this tumor depends and forms part of the sarcoma of the superior jaw. As it regards the exostoses of the alveolar depths, it can easily be recognised by percussion, and thereby prevent it from being confounded with epulis, even with those which have a firmness nearly cartilaginous.

Epules may, to a certain degree, hinder mastication, and oppose the clearness and even the possibility of pronunciation; they loosen the teeth, and compel them to deviate from their true position. They may, according to their nature, remain stationary a long time, or develop themselves and rapidly enlarge, ulcerate, exhale a fetid odor, occasion the engorgement of the lymphatic sub-maxillary glands, and even give rise to a cancerous affection of the portion of the bone to which they correspond. Dr. Lachaise has related to us an instance of a woman, inhabiting the village of Vigey, with whom an enormous epulis, of a soft and spongy nature, unceasingly covered with a purulent matter, had occasioned a great change in the digestive organs, and a kind of aneuric cachexia, against which every remedy failed, but which disappeared rapidly by the ablation of the tumor, and by the cauterization of the surface that it occupied in the superior jaw. No doubt that the purulent absorption was the cause of the general disorder of the economy, and it is evident that this disorder yielded to no other means than the destruction of the epulis.

Notwithstanding all that which we have said of epulis, that these are not, in general, serious affections, they are as easily cured when brought on either by decay or necrosis of the maxillary bone. In both cases, they cease to reproduce only when the diseased part of the bone is restored to its natural state, that is to say, when the decayed part of the bone is destroyed, and when the necrosis is exfoliated, as we shall prove by the observations we shall make in speaking of necrosis of the alveolar border.

Their treatment is, of necessity, deduced from the facts which

we shall state. Thus, symptomatic epulis, resulting from the decay of one or of more roots of teeth, disappears, sometimes, after the extraction of these latter; but it is always more prudent to extract them with a bistoury, or with scissors crooked upon the side; also, after the extraction, to await the spontaneous bleeding. A moderate flowing only of blood, after this operation, may be advantageous; we can make it cease at pleasure, by the use of alcoholic or slightly astringent gargles, or still better, by a moderate pressure, exerted some minutes.

Erectile and pedicled epules may be tied or excised; if their pedicle is straight and sufficiently elongated, so as to permit the finger to pass behind it, it can be torn or pulled off; Begin gives us an example of this; he thus expresses himself: "A young officer, who came to consult us, from the Val-de-Grâce, had, for some months, an epulis, whose size equalled the egg of a pigeon, situated upon the internal side of the right branch of the inferior maxillary, which covered, in some degree, the tongue, and thus impeded its movements. By examining the tumor, I found it supported by a pedicle so straight and so yielding, that, by passing my finger under it, so as to form a crotchet, I broke it without any effort, and it fell from the mouth. After a considerable flowing of blood, the patient departed, and experienced no relapse."

If, on the contrary, they have a large base, we should extract them carefully, with a cutting instrument; and, in every case, it is necessary to cauterize the surface from whence they were removed, as much to prevent their reproduction, as to arrest the hæmorrhage which habitually follows the operation. Cauterization, performed by means of iron, heated red hot, merits, in this case, the preference over that which is effected by chemical agents, because it is more prompt, easier to limit, of a readier application, less painful, and principally because it prevents, more certainly, the return of the disease. The following observation confirms the justice of this assertion.

In 1832, a lady, from forty to forty-five years, consulted us in regard to an artificial plate, by means of which she desired to replace four teeth, which were wanting upon the right side of the inferior jaw. The space that the lost teeth had caused was

filled by a fleshy tumor, large at the base, which appeared to be only the result of the thickening of the dental alveolar membrane. We proposed to her that we should first remove this tumor; but she preferred that a physician should perform this operation. He removed it effectively with a bistoury, and believed, after frequently applying nitric acid, that he had destroyed the parts which had escaped the instrument. Three months after, she again returned to see us, and we found the place that the tumor formerly occupied, covered with small lardaceous tubercles, of a cancerous appearance. We then learned that cauterization had been effected by means of nitric acid, whose effects were limited with much difficulty each time. We advised, without hesitating, the cauterization of this diseased surface with red hot iron. The patient consented; a month after, the toothless space had cicatrized, and we were able to apply there a plate, which gave no inconvenience.

Tumors or Scirrhus Epules.—Hard, rough and scirrhus epules are those which deserve the fixed attention of surgeons, as they may have dangerous consequences. It would be unsafe to await, in order to remove them, until they become very large, painful and ulcerated; their complete extirpation cannot be effected too soon. After having carefully removed them with the bistoury, and cleaned with precaution the surface of the alveolar border, if there are any adhering portions, it will be necessary then, more than in any other case, in order to prevent their reproduction, to cauterize the surface of the wound with red hot iron. In regard to tumors of this nature, which have been abandoned too long to themselves, or exposed to improper treatment, which may change the bone to a considerable extent, we are obliged to make a resection of a portion of the maxillary bones. Professor Lisfrance was compelled, recently, to resort to this means.

In May, 1840, we saw, in the service of Valpeau, to the Charité, a man who had, upon the alveolar border of the superior jaw, an epulis, which he attributed to the extraction of a tooth, the operation being performed in his fiftieth year; the epulis was constantly reproduced, notwithstanding it was believed to have been destroyed several times, either by the bis-

toury or by caustic. Valpeau employed, in order to remove it, a kind of excising forceps, the end of which was bent upon the side, nearly horizontal to the two branches, it was very convex outwardly, and terminated by two hollow cutting edges inwardly, in such a manner as to present a concavity large enough to contain the parts which should be removed. These pincers, applied upon the diseased alveolar border, removed, by a single effort, all the affected portion, which included at once the soft and bony parts. The amputation or resection of the jaw is thus sometimes avoided.

Tumors of this nature arise, very often, in the alveolar tissue ; we shall proceed, then, to the description of the diseases of the alveoli, to which they seem particularly related, although, in observing them with much attention, we discover that they often arise, if not from the tissue of the gums themselves, at least from the membrane, which, after having lined them, enters in the alveolus, and from thence into the subjacent osseous meshes.

Diseases of the Alveoli.

The lightness with which most authors who have written upon our art have treated of the diseases of the alveoli,* must astonish physiologists, who consider, as we ourselves have done, in our anatomical part, these bony partitions as belonging more particularly to the teeth than to the jaw bones. Practitioners, whose daily experience teaches them that they are nearly always affected, in a direct or sympathetic manner, by the diseases of the teeth and gums, and that they are, moreover, exposed to particular morbid states, so important as to deserve serious attention, must, above all, be surprised at this negligence.

We judge it proper to examine them in the different pathological states which are most common to them, such as their primitive narrowness, or their impeded development, and its consequences, the inflammation of their membrane, their extreme thickness or wearing away, their fracture, and, finally, their necrosis and cancer, etc.

* Maury does not speak of them ; Lemaire says very little ; Lefoulon does not say a word, etc. etc.

The Primitive Narrowness of the Alveoli.—Nature has, very certainly, arranged and disposed all things for the easy and regular execution of all the functions of the organism: experience, however, proves that a number of circumstances may, even in the course of fœtal life, oppose themselves to the free development of certain parts, and thus produce a very prominent obstacle to the execution of the functions which belong to themselves, or to other organs to which they are united by the designs of a common end. It is thus, for example, that the uterus may be perfectly formed, and the accouchement rendered difficult, or even impossible, only by the congenital narrowness of the bony opening of the basin through which the product of conception must pass, etc.

May this not, then, be the case with the germs of the teeth, and the bony cavities which they must pass? However remote it may be from our intention, to participate in the exaggeration that generally reigns in regard to the estimation of the phenomena of dentition, we are, nevertheless, obliged to admit, with Baume,* against the plain but too exclusive opinion of Laforgue,† that, in some cases, the gums are not the only obstacles which oppose the efforts which the teeth make to appear. In effect, the too contracted superior borders of the alveoli, that is to say, the narrowness of the passage through which the teeth must pass, may also be an obstacle capable of perpetuating the pain, until it is insurmountable, and of increasing the other accidents so much that we are compelled to employ means which may be more hard and more painful than the simple division of the gums, yet they do not constitute *a terrible operation*, as the last author that we have quoted would have us believe.

The resistance occasioned by the gums, and the narrowness of the alveoli, are two cases, doubtless, difficult to distinguish; nevertheless, with attention and the habit of close observation, we may discern them. Although the gums, on account of their density, resist the action of the teeth, and oppose their cutting through them, we see, notwithstanding this obstacle, the teeth

* *Treatise upon First Dentition*, Paris, 1806.

† *Theory and Practice upon the Art of the Dentist*, vol. 2, p. 263.

forcing themselves without their alveoli, advancing and pushing the gums towards the interior of the mouth, because they resist the action which tends to divide them; they yield, nevertheless, to the impulsion that these organs exert upon them.

This phenomenon, which is very apparent, says Baumes, does not take place, when the obstacle depends upon the narrowness of the orifice of the alveolus. The resistance that affects the edges of this orifice prevents the tooth from elongating from the side of the gums, and pushes them before it. The efforts which the teeth make to this effect, reacts upon the depths of the alveoli; the periosteum which lines these small cavities is compressed and bruised by it; the fillets of nerves which belong to each root are drawn and irritated by it; violent pain results from it, and consecutive accidents sometimes manifest themselves in the most unquiet manner.

In this latter circumstance, the gums which cover the alveolar border appear every where equal; no part of their surface is elevated, because the teeth, being retained in their alveoli, cannot affect them. Finally, the exclusion of the signs, which we meet with in the first state, might appear sufficient to induce us to suspect that of which we are now treating. The alveolar orifice does not always form, by its contracted border, a circular barrier, which opposes the progress of the teeth; sometimes, only one part of this border is an impediment, whilst the other, more depressed, does not cause any hindrance. In this case, the tooth may appear towards the tongue, but it appears in an improper place, and cuts through upon the side which offers the least resistance; this may be one cause of so frequent an irregular denture.

We will now briefly notice, with Baumes, that the cases of which we shall now speak, and which may cause serious accidents, are, fortunately, very rare; but the bare possibility of their existing at all is sufficient to impose upon us the necessity of calling the attention of young practitioners to them.

Thus, then, if after having incised the gums, we perceive that the obstacle impeding the cutting of the teeth proceeds rather from the contracted alveolar orifice than from the density of the soft parts, we are satisfied that the division of these latter would not allay the unquiet symptoms; it is necessary to take another

course ; this must be the removing of the osseous parts of the alveolus, which constitute the obstacle. In order to accomplish this, we should employ cutting pincers, and we might better extract this osseous part, from its circumference, by scissors. This part is not very resisting, and can be removed with little force.

The tooth then possesses the power of advancing, and the subjacent periosteum being no longer compressed, the accidents which result from this compression appear only in a feeble degree, or are dissipated altogether.

The Inflammation of the Alveolo-dental Periosteum, and Alveolar Cysts.—The alveolar borders, as we know, are lined, interiorly, with a vascular membrane, analogous to the periosteum of the other bones. This membrane may, under the influence of a number of causes, become the seat of an inflammation, acute or chronic, and whose termination may be a complete resolution, a purulent flowing, or the formation of a true phlegmasia. It may also furnish the constituent elements of a cyst.

In the acute state, this inflammation is characterized first by a dull pain, then piercing and pulsative, appearing round the healthy tooth. The gum soon swells and becomes red and painful, the swelling even reaches sometimes the jaw. A state of vacillation follows, which is more apparent in this than in any other affection ; this state is so obvious to the patient, that he imagines either that it will drop out of itself, or that it may be extracted by the slightest effort.

This is an error that must be opposed in every instance ; for this vacillation, which appears so great, is none other than the natural movement, which, although insensible in the normal state, is rendered apparent by the augmentation of the sensibility of the periosteum, and the admittance of the fluids which engorged it tends to remove the alveolar walls ; the teeth are not then less solid or less difficult to extract.*

* This explanation will suffice to destroy, in the case, unfortunately so common, where extraction is absolutely necessary, the hope that the patient may have indulged in, viz. that he will not have to endure the operation, and prevent him from accusing the dentist of having been the cause of pain which they might have believed would not have been necessary if this explanation had not been made.

When this inflammation is chronic, it is ordinarily induced by some internal cause, such as a scrofulous, scorbutic, venereal or rheumatic state. Between the teeth and gums, then, there is formed puriform and fetid matter, which loosens the former and softens the latter. In this case, the affection is sometimes very difficult to cure; it ordinarily causes the consumption of the roots, as we have already said, and sometimes the destruction of the alveolar partitions, as we will soon see.

The treatment of this disease varies, according as it is acute or chronic. In the first case, it is remedied, as all the affections of the same nature, by emollient and narcotic gargles, by leeches placed below the angles of the jaws and even upon the gums, by foot-baths, and by lukewarm and emollient drinks. During the chronic state of the disease, it is important to wash the gums frequently, with liquids aromatised by bitter, astringent and spirituous liquors. It is sometimes requisite, in order to arrest the disorganizing work which consumes the roots, to apply a cautery or blister upon the neck or behind the ears.

Cysts, which develop themselves so frequently upon the maxillary bones, form a kind of affection, of the existence of which the ancients were completely ignorant. Bordenave* made some conjectures respecting them, but Hunter in his works, and Dupuytren in his anatomical researches, give undeniable proofs of them. M. A. Forget has recently made them the subject of an introductory lecture,† and of a very interesting treatise.‡

These cysts contain solid matter or simply liquids, as of serosity, either pure or mixed with blood, of pus, of hydatids, and of mucous matter. The first, much more common to the inferior than to the superior jaw, occupy the small areas of the spongy tissue, whilst the second, that is to say, those which contain the liquid products, are more superficially situated, consequently they border upon the alveolar ridge, and develop themselves, in a great number of circumstances, in the alveoli.

Doubtless that, in this case, their walls are not formed by a

* Work quoted.

† *Thesis* before the Faculty of Paris, 1840.

‡ See *Gazette of the Hospitals*, 27th of August, 1840.

prolongation of the alveolo-dental membrane. Many facts confirm this opinion. The most prominent is that of the extraction of the first small molar, whose two roots carry with them a vesicle of the size of a large pea. We believed, at first, that this was one of those fleshy tumors, a kind of vegetation with which the extremities of the roots are so often furnished; but, by examining it with care, we attributed it to fluctuation, and, having opened it, a viscous fluid escaped, and, by the use of the microscope, we discovered some hydatids. By probing the place which this tooth had occupied, we perceived a vast oblongated cavity, and altogether proportioned to the volume of the tumor. The patient had experienced only an obtuse pain, whose continuity, more than its intensity, had induced him to have the tooth extracted, and the augmentation of the thickness of the alveolar border, in the corresponding portion, was made in a manner so progressive, that it was not perceived by him until it was very prominent.

Exostoses of the Alveoli.—The alveoli may, as all the other parts of the osseous system to which they belong, become the seat of a swelling, or of an enlargement of volume, as we have said in regard to the teeth.

This pathological state, confined to a single point, and circumscribed in its form, constitutes a true *exostosis*. This is sometimes the case with that part of the alveolar border formed by the union of the superior maxillary bones. Then the central incisors, generally situated very near, commence to separate in such a manner that a tooth appears to have been extracted between them. This circumstance affects, sometimes, the symphysis of the inferior jaw.

The tumefaction of the alveolar partitions, instead of being a true exostosis, may be a simple increasement of volume. Fox relates a case of this kind, in which these partitions were so large, in the posterior part of the superior jaw, where the molars only existed, that the jaw appeared to be swollen, thus causing a great deformity. He extracted the teeth, hoping that the tumor might be diminished by the absorption of the alveolar partitions, an absorption which is always the result of this operation. The tumor diminished, and the progress of the disease

was arrested. This example may serve as a guide in similar circumstances.

As it regards exostosis properly called, we believe that the extraction of the tooth corresponding to the alveolar partition upon which the tumor is developed, will be the only course to pursue, if this latter constituted a serious deformity, or impeded either the movements of the tongue or the lips. The result would be one of the following two: either, by the extraction of the tooth, the portion of the exostosed alveolus would separate with it; or, if this remaining portion remains, the obliteration of its cavity will be effected by the approximation of its edges.

Independently of the two kinds of exostoses that we shall describe, and which exist, viz. the first in a thickening of the alveolar partition, and in a kind of accumulation upon some part of their walls, of an exuberant quantity of calcareous salts; these cavities may be either the seat, or the point from whence a soft or spongy tumefaction proceeds, which Astley Cooper has named *fungous exostosis*, and of which he gives the following example:

"William, aged thirty-two years, came frequently to the consultation of the Hospital of Guy. He had, in his inferior jaw, a *fungous exostosis*, which caused a large projection in his chin. The tumor had commenced six years before, by the vacillation of the teeth, followed by their loss. Upon the alveolar cavities, fungous productions appeared, of a violet red color, which, after a certain period, gangrened and disappeared; then the gums cicatrized. The jaw now commenced to tumefy, the fungus re-appeared at the expiration, of about two years, and again disappeared. At this period, the maxillary bone could be penetrated even to the top of the chin. A voluminous tumor formed from thence, upon a level with the symphysis, and gradually increased, accompanied with little pain. Finally, the skin of the chin is ulcerated; the fungus projects forward by this ulceration, and two other red and violet projections appear upon the gums."

This is the same kind of affection that Doctor Hugier, admitted surgeon to the faculty, called *areolar exostosis*. He has

submitted many cases to the royal academy of medicine, and he has given a remarkable one to the hospital of the school. The following is a summary of it:

Maria Marg. Foiret, aged exactly sixteen years, had a violent fall upon her face, in her sixth year. During the first six months, she experienced pains in the right superior molars; but, at the expiration of the year, a hard and very painful tumor appeared in the canine fossæ, between the jaw and the molars; it increased slowly until it acquired the size of a large orange, without, however, being followed by any pain. When the interior of the mouth was examined, the right alveolar border was thickened, depressed and thrown outwardly, and in consequence of the development of the tumor, the face was deformed and the mouth could not be closed. Her general health, however, was good, and no engorgement of the lymphatic glands, neither of the head nor neck existed.

Although this affection had a great analogy with osteo-sarcoma, Hugier, however, did not doubt its nature. He, nevertheless, made a puncture, from which only a few drops of pure blood issued; he then extracted the incisor, and the first of the two molar teeth which remained, preserving the latter which belonged to the healthy parts and which served, at a later period, to prevent the inferior jaw from sinking to the right. Finally, after having made an oblique incision in the inferior and posterior angle of the bone of the cheek as far as the superior lip, in order to manage the fillets of the facial nerve and excretory duct of the salivary gland, he exposed the tumor, divided the mental apophysis of the maxillary, and *os unguis* with the gouge and mallet, separated the bone from the cheek of the zygomatic apophysis with a *circular* saw, finally detached the anterior and inferior part of the maxillary partition with a pair of scissors.

The Wearing Away or Absorption of the Alveoli.—This organic change, altogether opposed to the *exostoses* of the alveolar partitions, consists of their disappearance, or the gradual absorption of their substance. As this change generally takes place from the fortieth to the fiftieth year, a period when man has always passed the meridian of life, one is led to believe that it is the natural result of old age; and if it happens sooner, as is generally the

case with the alveoli of those teeth which cease to be united, we believe it can be explained in this way, that the empty alveolus approaches its walls and becomes absorbed in its ridges. But this pathological state can no less exist as an affection independent of the two causes that we have mentioned, viz. the age and vacuity of the alveoli.

When the alveolar ridges are effected by absorption, the gums of which they are the support, partake inevitably of the effects of this disease. In effect, in proportion as the osseous substance of the alveoli diminish, the gums cease to be united with the teeth, the necks of which are exposed and which appear to grow. When this change takes place in the alveoli in the two jaws, the teeth not only appear to lengthen, but seem to be still more distant from each other than heretofore; in the mastication of hard substances, also, becomes much more difficult.

When once this condition takes place, the tooth vacillates, elongates and becomes inconvenient, because it prevents the use of that side of the jaw which it occupies, so much so that its extraction is necessary; but another tooth soon experiences the same fate, and then another, until the jaws are deprived of all the teeth. Sometimes, nevertheless, the absorption is confined to two or three teeth, the alveolar partitions are effected only in part, and after the extraction of these teeth, no other indication of the disease remains.

The abandoning of the root by the alveolar border, and the gum to which this latter gives strength, may be only the result of the absorption of the alveolar ridge; but very often the tooth is forced from its osseous socket by another cause, viz. the contraction of the alveolus which it fills. Fox treats of this diseased state separately; this is an error according to our opinion; for as his translator justly remarks, this contraction rarely takes place without being preceded or at least without accompanying absorption, it is probable that both are produced by the same cause; that they are two characters of the same disease, or, if we prefer it, and this seems to us very admissible, two simultaneous results of a disorganizing work by which the alveoli are affected and the natural tendency that they possess to obliterate themselves by the approaching of their walls as soon as they

cease to be occupied by the teeth, or that they, by the loss of their vitality, are reduced to the state of inert bodies.

The disappearance of the alveoli, as an affection independent of the progress of age of the vacuity of their cavities, has been a long time a constant and incontestible fact to us ; for we have met, as partsof pathological anatomy, many inferior jaws which, by the obliquity of their branches, the small development of their muscular parts, the length of the wisdom teeth, denoting clearly that they belong to young subjects, and upon which also the destruction of the alveolar borders, as far as the body even of the bone, proved that the cavities of this border was deprived, had disappeared, under the influence of some other cause than the simple approximation of their walls. But although nothing from thence proves that this disposition had been the result of a disease of the gums, of the alveolo-dental periosteum, or of an affection of the roots of the teeth which communicate so easily to their osseous envelopes. The following fact destroys all doubt upon this subject: a man from thirty-six to thirty-eight years of age, removed some months since to Paris, after having inhabited a long time the colonies, and came to consult me in relation to many teeth of the inferior jaw, which were so loose that he believed that he should lose them. Supposing that this fear on his part was only the effect of a sensibility excited by the parts in the midst of which the teeth were placed, I assured him of it at first ; but having examined them with more attention, I perceived that they were not really held by the jaws ; for, so to speak, nor by the adhesion of the gums to their necks which were completely exposed, but by the connection of the gums to their roots which were abandoned by their osseous sockets. The gums were of a vermilion color, but neither bloody nor tumefied, and a pressure exerted upon them did not cause any puriform fluid to escape which might lead us to believe in the existence of disease in the periosteum. Being convinced, then, that there was no hope of saving the teeth, we did not hesitate to advise the extraction of them, in order that by so doing the patient would escape the pain which their presence would cause. This counsel was followed ; the gums soon sank down even upon the body of the

maxillary deprived of its alveolar border, and, six months after, artificial teeth, with colored gums, were applied without causing the least pain.

We have not considered as yet the disappearance, or the absorption of the alveolar partitions as a primitive state; but that which we shall now say, will demonstrate this change may, it is also frequent, depend upon a chronic inflammation of the gums transmitted to the alveolo-dental periosteum, and from thence to the osseous tissue itself, which causes a disorganizing work to proceed more easily than it is naturally disposed to do. We meet with this very frequently among persons whose teeth are covered with tartar, and with those whose gums are the seat of an intense scorbutic affection. The single designation of the cause, in these two cases, suffice to make known the therapeutic indication. We have a specimen which proves, also, that, in this kind of absorption, the effects are not always equally felt by the external and internal walls of the alveoli; for in this specimen, the osseous portions, by their disappearance have completely exposed the roots of the anterior teeth, whilst they are untouched backwardly.

Fractures of the Alveoli.—The fracture of the alveoli without being a very common accident, is, however, a very frequent one: all the causes which may occasion the fracturing of the teeth may also cause that of the alveoli. Exterior violence, as blows, falls, directed immediately upon the teeth, frequently do not effect but occasion serious disorders in the alveolar border; this may be explained by the concussion which the alveoli receive from the roots and which is often so great as to fracture them.

When these fractures depend upon the causes that we have mentioned, they ordinarily affect the exterior wall of the alveolar partition, because the blow, taking effect first inwardly, then outwardly, acts upon the crown of the tooth in the mouth, and then reacts upon the root in a contrary manner. In elementary language, we would call these fractures, *indirect fractures* or *contra blows*, in opposition to those resulting even from the pressure of the neck of the tooth upon the alveolar border, would affect this border inwardly and therefore be direct.

But of all the causes of these fractures, one of the most common, it is necessary to say it, although not a very flattering acknowledgment from our art, is a badly performed operation in the mouth, and, if it is necessary to specify cases, we would not hesitate to quote, in the first place, the use of the key of Garangeot; for we can prove, in treating of the extraction of teeth, that this *dangerous* instrument, which is only fit to mask the unskilfulness of the operator, to the detriment of the operation, is one of the most defective of surgical instruments, and that no workman of good sense, being convinced of its mode of action, would attempt to employ it if he wished to extract a nail from a hole if he did not desire to break the wall.

Whatever may be the causes of these fractures, to which the alveoli may be predisposed by the fact of a pathological state, it is always prudent to seek to reunite the separated osseous parts, particularly if the fracture occupies a large space, if the gums still retain the fragments in place, and more particularly, finally, if these fragments are attached to one or more teeth, whose loss, we do not cease to repeat it, is always a serious event. The reduction of the parts being affected, it is sufficient, in general, in order to maintain them in place, to press them lightly by a piece of linen, rendered fixed by a metallic plate, or by a thread of silk passed many times around the neighboring teeth.* But if it is a comminuted fracture, it would be better to remove the splinters and to oppose local accidents by ordinary antiphlogistic means.

One of the most extraordinary cases that we have met with, is that of a young officer of cavalry, who fell from his horse with his face upon the ground. The six lower anterior teeth, having received all the effect of the fall, were driven inwardly, without being fractured, but their roots broke the anterior walls of the alveolar border, not only in the space that they occupied there, but as much on the other side, in a horizontal as in a vertical direction. The military surgeon was immediately called in, having the hope not only of preserving the fractured osseous

* We are far from giving this advice as new, for we give it in the same words (but translated) as Hippocrates.

parts, but the teeth which were adherent to them, constructed a fixture of tin, which enclosed the dental arch and the alveolar border, was attached to the last large molars. The patient soon experienced a dull pain, and, shortly after, a purulent and fetid flowing commenced from beneath the fixture.

At this period we were consulted. As soon as we could examine it, we did not doubt but that the consolidation of the fractured parts had not taken place, and we immediately advised the removing of the fixture. We then found the gums horribly tumefied, and by pressing lightly upon them we caused the osseous fragments to move about, and a great quantity of pus to escape. Our first care was to separate the soft parts, which retained the splinters, and to extract them. Cicatrization soon followed. At a later period, we made him an artificial plate, which perfectly concealed the great loss of substance which was the result of his fall.

Necrosis and Cancer of the Alveolar Border.—When the alveolar border has been broken by any cause, we perceive very plainly, as we shall demonstrate, that the portion which has been fractured may remain adherent to the rest of the bone, and may finally consolidate there in a definite manner. But very often this portion mortifies for want of sustenance, in a word, it *necroses*, and finally separates altogether from the maxillary.

The fractures of the alveolar border are, then, the most frequent causes of their necrosis.

These are, at least, the most frequent cases that we have met with, for we have nearly always been able to discover that, from periods more or less anterior to the time when we had noticed the necrosis, the patient had undergone some operation to which it was rational to attribute it to. But it is no less true that a portion of the alveolar border may be necrosed, without having been primitively fractured, or without our being able to discover the true reason of it.

This pathological state had not escaped the observing mind of Hippocrates, as the following phrase proves: "After some pain that the son of Metrodore experienced in his teeth, a great tumefaction of the gums followed; they suppurated a little, a

portion of the gum detached itself with the molars which were implanted there.”*

Some years since, we ourselves met with an instance in which we extracted, for a youth of seven or eight years, apprenticed to a shoemaker in Planche-Mibray street, a canine and the two small superior molars upon the left side, to which a considerable portion of the maxillary adhered, which, unfortunately, contained the germs of the secondary teeth. After an attentive examination, we were induced to attribute this accident to a scrofulous affection, of which he bore the marks.

This species of necrosis is sometimes also the result of a state of extensive deterioration, into which some infants are thrown by some eruptive disease. Duval relates a curious case, resulting from the small-pox, thus :

“M. Boyer and myself had occasion to see a similar case, in a little girl of seven years ; she had had, in July, 1807, the small pox, which, by its complicated or bad character, required the application of blisters upon the legs. An abscess, which was upon the maxillary bone of the right side, appeared to have been the termination of the disease. At first they considered it as fluxion, and paid it little attention ; the disease having, however, progressed, although slowly it is true, and which they thought might perhaps result in the death of the child, we were consulted about the commencement of January. By examining the interior of the mouth, we easily discovered that a portion of the maxillary bone was necrosed ; the bone was denuded an inch or more, and we perceived the two milk molars shaking in their sockets.

Being persuaded that nature alone, in this case, would be the best physician, we were content to try its care, whilst we seconded its efforts. The pure air of the country and much exercise, assisted much in the cutting of the incisors, and, at the end of July, that portion of bone that was necrosed yielded to the feeble efforts of his hand, and by its removal caused a complete cure. The osseous fragment which was detached had in it nearly fifteen lines ; its form was irregular, in

* De Morbis Vulgaris, fifth book.

consequence of these asperities. This fragment was the middle portion of the alveolar arch, into which were implanted, at the time of its removal, the two milk molars. Between the roots of the teeth were also embodied in their alveoli the crowns of two small molars of replacement, whose roots were not yet completed."*

There was, in the Charité hospital, (in December, 1842,) a man who was also an example of this. Let us observe the state of this patient, and the summary of the clinical lecture of Valpeau, of which he was the subject; a summary which gives, at the same time, a description of the disease, and the indication of the disease which is applicable to it.

At his entrance into the hospital, this man had, upon the right side of the alveolar border, a tumor, dated from six to ten months, and whose origin was obscure. He related that he had experienced, towards this last period, a pain in the right side of the jaw, but without having had any of the teeth defaced. A very considerable swelling followed, which, after many months, formed a tumor, of which the termination was a purulent collection. If a tooth had been extracted during this tumefaction, the pus would have passed through the emptied socket, and the pain would have completely ceased.

This man was pale, but did not, however, present that yellowish tint, the indication of cancerous cachexy. It appeared that he had, also, in the origin of his disease, an engorgement under his jaw, but which had completely disappeared; we did not find any trace of the absorption or wasting away of the tissue. Between the canine and the molars of the inferior border of the right side, we remarked a slope, caused by the absence of many teeth; it is in place that we, by a light pressure, caused the pus to flow. We perceived there, also, a hard grey plate, which was a portion of tumefied bone. This piece of bone might have been taken for an old root, if we had not distinguished there the alveoli, which did not permit us to doubt the necrosis of a part of the jaw. By examining attentively, we assured ourselves that it was not the alveoli from whence the

* Historical Researches upon the Art of the Dentist, etc.

pus departed, since the patient also assured us that he very plainly perceived the pus gliding between the gum and bone itself.

Valpeau assured us of it more directly still; he glided a stylet between the parts that we have mentioned, and met a considerable portion of the bone of the jaw completely denuded.

It was not possible for us to know precisely to what extent the denudation existed. All that we know is, that, notwithstanding the considerable depth to which the stylet had penetrated, the disease did not appear to reach the maxillary tissue, for nothing, in this place, indicated the mortification of the bone itself. The treatment of a simple necrosis, and of one complicated of a cancerous affection, should be altogether different. If the necrosis is simple, the operation may be simple, and the consequences scarcely dangerous; but a cancerous affection is followed by serious consequences. The following we believe to be very nearly the words by which the honorable professor has sought to establish his diagnostic:

"Cancers of the jaw ordinarily commence by the appearance of some morbid growths, without any pain; an acute pain may follow suppuration, but never precedes nor accompanies the character of the true phlegmon. When the pus creates a passage, the tumor does not disappear from that, but the tissues of the region harden, and fungosities soon appear. Now, in this kind, the pain has preceded the swelling, and this swelling has been rapid, and transforms into an abscess. It then has all the symptoms of a purulent inflammation. When a tooth has been extracted for the patient, the pus proceeds out from the empty socket, but there the tumor has diminished in volume, and, finally, the disease exists under the form of a suppuration, brought on by its sequestration. There is, then, every room to believe that this disease is a simple necrosis, and not a cancerous tumor, and that the cure may be easily made." The consequences have proven that this judgment was correct.

As it regards the cancer of the alveolar border, we may add to that which Valpeau has said, that it commences either by the soft parts, or by the bone. In the first case, it attacks, first the lip, and from thence proceeds to the jaw, for the same rea-

son that a cancer of the breast attacks the sides ; in the second case, it commences from a small, soft, fungous tumor, in the depth of the alveolus, after the extraction of a tooth, and declares itself, ordinarily, by the non-effect of excision and cauterization. All that we can say, in this respect, is, that the only proper course of treatment, is the extraction of all the affected parts. The conduct of Valpeau, quoted upon a preceding page, may serve as an example for the operator.

PART SECOND.

OPERATIVE MEDICINE AND PROSTHESIS, OR MECHANICAL DENTISTRY.

CHAPTER I.

OPERATIVE MEDICINE.

OF all the organs which nature, on account of their diseases, placed in the special domain of surgery, there are none, assuredly, with which this branch of the therapeutic art has more to do than with the teeth. From the incision of the gums, the object of which is to facilitate their eruption, to that extreme remedy, their complete extraction, the operations to which they are submitted, form an immense field; and the cultivation of this field requires so much the more exact knowledge and skill, because the results are appreciable to all; and because errors when they are committed, not remaining buried in the thickness of the tissues, are exposed to the severest criticism.

Amongst these operations, which, to tell the whole truth, constitute the essence of our art, the object of some is either to destroy the obstacles which oppose themselves to the free eruption of the teeth, and to facilitate their regular arrangement, or to disembarass them of every thing which has a tendency to affect their health or beauty; the object of another class of operations is either to furnish a remedy for the many alterations to which these organs are subject, and which may cause their loss, or to consummate, partially or entirely, this loss itself, when it is demonstrated that their preservation can only be purchased at the expense of the general health, or the injury of the adjoining teeth.

In the chapter devoted to hygiene and orthopedia, we have developed, in as full detail as was proper, in an elementary

treatise, the rules according to which the first class of these operations, such as *cleansing* and *correcting irregularities of the teeth*, should be executed; we will now turn to the second class, which as they are resorted to only when actual disease is present, constitute more legitimately, operative medicine; such as, *filing, cauterization, obliteration, luxation, excision*, and, finally *extraction* of the teeth, with all its consequences.

With regard to the question, which has been so often discussed as to whether it is absolutely indispensable that the surgeon dentist, should be able to perform all operations with equal facility with both hands, that is, should be ambidextrous, it is our opinion that every thing in relation to this subject should be reduced to this rule: although it is, no doubt, rationally possible to demonstrate, in theory, that it is much more easy to operate on the right side of the mouth with the left hand, and *vice versa*, it should not be forgotten, that as persons naturally ambidextrous are very rare, it is better, generally, to waive the advantages offered by a more convenient position, than to run the risk of operating with an uncertain and unsteady hand. Besides this, there are operations which, for want of sufficient power, could never be executed, except with the hand we use habitually, no matter how much the other may have been exercised in particular cases.

Having disposed of this matter, we will now proceed, but not after the example of most authors who have, heretofore, written elementary treatises on our art: that is to give general rules, simply, we shall enter into all the necessary details with regard to each operation, and reduce the various steps to data sufficiently exact, to enable the tyro to apprehend, at once, their spirit and object, so that he will not be exposed to the risk of making bungling and ineffective attempts, which will, invariably, cause the patient to doubt his skill and experience, which, and these may as readily be supposed, it is always desirable that he should have.

But before commencing a description of the manipulations, we will repeat what we have already said, that the dentist should have the precaution to wash his hands, and that he should place his patient in a good light, in an arm chair with a large

seat, with four feet, and of sufficient solidity to resist all the movements of the patient, and the force of the operations. This chair should be provided with strong arms, so that the patient may, as it were, cling to them; it should terminate, posteriorly, by a back piece, the upper border of which should, in general, be horizontal, but rounded and covered on the sides, so that the head which, in most cases, rests upon it, may not be hurt.

As to a chair arranged either with fixtures to give the head any desired inclination, the advantages of which have been so much preached about, or a screw to raise and lower the head-piece according to the height of the patient, we think that although it may be useful it is not indispensable. The dentist should, indeed, accustom himself to operate in chairs of all forms, for, in case he should be called out of his office, he would find himself much embarrassed if he had always operated in a chair of a peculiar kind. Under such circumstances it should be sufficient for him to place a pillow on the back of the arm chair, or perhaps the simple chair, which is placed at his disposal.

We will also remark, that the dentist should not only have immediately at hand all the instruments he will need, the principal merit of which should consist in their being suitable and strong, but he should avoid, as much as possible, making a display of them before his patients. This makes it necessary, in our opinion, that he should keep them in the same apartment where he operates, shut up in drawers, and arranged according to the order in which they are used, that is to say, all the extracting instruments should be together, and in like manner, the files, scaling and cauterizing instruments, etc. so that they can be taken up promptly, and that the delay, which would occur if it were necessary every time they were used to select such as were wanted, may be avoided. It is almost unnecessary to say that all the accessories of the instruments, such as the spittoon, towel, hot water, etc. should also be provided.

There is one thing which it is important to form a habit of doing, that is to place yourself in the most convenient position, but it may be very readily seen that it would be difficult at the outset, to establish any general rules for this purpose, as this position must vary every moment, not only as regards the par-

ticular operation itself, but also the various steps of each operation. All we can say about this matter, in general, is, that in operating upon the upper jaw the operator is obliged to place himself, standing, *behind* the patient, and in operating upon the lower jaw, he, on the contrary, should place himself *before* his patient, with one knee on the floor, on the right or left side as the case may be; ordinarily, however, on the side opposite to that on which the operation is performed. By placing the knee upon the floor, the operator is brought more on a level with his patient, his movements are made more conveniently, and it is much more easy than if he kept himself in a bent position, which would be necessary if he operated standing.

In most cases, the fingers are sufficient to hold the lips apart; but quite often, in the cases of individuals, the muscles of whose lips, especially those of the lower jaw, are endowed with great contractile power, an apparatus, made to effect this object, should be used. We have one constructed of platina; it is a species of ovoid circle, hollowed out in its circumference, in the form of a groove, which receives the lips, and keeps them forcibly apart; it is arched so as to accommodate itself to the form of the mouth.

The tongue, which is often troublesome, especially in the course of prolonged operations, may be kept out of the way, by means of a fixture, made of two semi-elliptical plates of box-wood, ivory or platina, applied, one to the roof of the mouth, the other placed upon the tongue, and kept apart by a piece of whalebone, curved backwards, and fixed by each end into sheaths made in the plates to receive them. The superior plate is terminated by an appendage which touches the posterior border of the alveoli and the teeth, in order to make a projection out of the mouth, by which the apparatus may be removed with facility and promptitude, in cases where it forms an obstacle which cannot be immediately remedied by the fingers.

We admit, as will be seen, that the mouth upon which an operation is to be performed, should be opened to a convenient degree. In those cases, which, happily, are rare, where the opening of the mouth is so small, owing to stiffness of the temporo-maxillary articulation, occasioned by certain chronic in-

inflammations of the pharynx, by intense phlegmasia of the back part of the mouth, especially when its seat is near the last molar tooth, it becomes necessary to effect the enlargement of this opening. For this purpose, wedges of cork or wood are used, the number and thickness of which are gradually increased. A commencement is made with a long thin wedge, which is pushed between the dental arches, as far back as the coronoid process; this is removed after it has remained in its position for a day, and is replaced by one of larger size; this is continued, from day to day, till the perfect mobility of the jaw has been completely established.

It will be very readily supposed that a wedge of cork or wood, placed between the dental arches, cannot be productive of the desired result, except in cases of immobility arising from accidental causes. Where the cheeks have become adherent to the gums, before any attempt is made to separate the jaws, it will be necessary to remove this obstacle, by destroying the adhesion; and, in true ankylosis, of the articulation, an operation becomes necessary, which belongs to general surgery. But if the occlusion of the mouth has been produced by a cause purely accidental, such as inflammation, it will always be prudent to wait till this has disappeared under suitable treatment.

If the dentist should be called in, either to a person affected with tetanus, to whom it is necessary to administer remedies, or to a person who has taken poison, and will not allow the administration of the appropriate antidotes, or to a person who has determined to starve himself to death, as has sometimes happened with lunatics of a certain kind, especially hypochondriacs, he can do no better, *if there is no breach in the dental arches*, than, with a chisel and mallet, to break away the two side teeth above and below, and introduce into the opening, thus made, a pair of forceps, the beaks of which separate as the handles are brought together; by means of this instrument, the external parts of the beaks of which are notched, to prevent them from slipping, and a rack-work fixed to the handles, to keep them firm at any point to which they may be brought together, the mouth may be kept open as long as it is desirable. Having been required, a few years since, to open the mouth of a young

girl, who, in a moment of desperation, had swallowed acetate of copper, we succeeded, with this instrument, so that the remedies which her condition required, could be admitted.

Finally, with all the operations which the dentist is called upon to perform in the mouth, after having invariably made an examination, with sufficient care to avoid the commission of error, and having informed the patient of the true condition of his teeth, he should act with promptitude but with safety; for, although it is important that he should do all that is necessary, with sufficient rapidity to avoid the anxieties awakened by delay, and to abridge the pain of the operation itself, it is indispensable, also, that he should foresee all accidents which may occur in consequence of too great precipitation, and those which accrue to practitioners who, allowing themselves to be alarmed or intimidated by the cries of the patient, lose that coolness which is necessary in order to act in accordance with the proper methods, and which is so important in the crowd of exceptional circumstances that may occur unexpectedly, to complicate the operation.

SEC. 1. *Filing of the Teeth.*

The file is an instrument in the most common use amongst dentists. It was, undoubtedly, used in the earliest days of the profession; but it seems, nevertheless, to have been unknown to Hippocrates, who, in speaking of ulcers of the tongue, says, that "ulcers of the tongue are sometimes caused and maintained by the roughness of a tooth," and makes no mention of the file; but Galen, his commentator, attributes to himself its first application to our art.*

This instrument is used in a great number of cases. Its application, most ordinarily, is to remove decayed portions of the teeth; to bring down to a level with the others, a tooth which is too long, and interferes with the perfect closure of the jaws, or injures the opposite corresponding tooth; to destroy asperities produced by caries or fracture, incommoding or wounding the

* Hippocrates lived about four hundred years before, and Galen not until two hundred years after, the Christian era.

tongue, the gums, the lips, or the cheeks ; and to prepare teeth, or their roots, for the reception of artificial teeth.

The form of the file varies, necessarily, according to the purpose for which it is used. Sometimes it is flat upon the sides, and rounded or square at the extremity ; sometimes, on the contrary, it is entirely round or triangular, or half-round, terminating in a point. It is, generally, cut on both sides and edges, and varies in size and thickness, according to the teeth for which it is used ; finally, it is sometimes straight and sometimes curved. The cut is both simple and double ; that which is oblique produces less jarring, but cuts more slowly than that which is cut twice across.

The file is generally fixed to a handle or file-carrier, when it is used for the large molars ; but this addition is more disadvantageous than useful, when we wish to operate upon the front teeth, for the reason that the file cannot be held so firmly as in the fingers, and is more easily broken. The file-carrier may be straight, but is very often curved, that is the portion in which the file is fixed by a screw, is bent at a right angle with the shaft ; by means of this arrangement, the commissure of the lips is avoided, a free field for the operation is obtained, and the teeth upon which the operation is performed are more easily seen.

The use of the file is subject to rules of two species. Some are applicable to the generality of cases, others relate to the special end which is to be accomplished. In general, the patient should be seated on a firm chair, in a good light ; the operator should hold the instrument between the thumb and fore-finger of the right hand ; from time to time, he should take the precaution to dip his file in tepid water ; this greatly facilitates the action of the file, and, in the winter time, prevents the disagreeable sensation which is always produced by a cold body coming in contact with the teeth. The operator should be careful to hold firmly, with his left hand, the teeth he files, in order to avoid loosening them, and to prevent all vibration. In cases where he has occasion to operate upon loose and painful teeth of the lower jaw, he should not, as has been advised by Maury and other writers, attach them to the adjoining teeth, no matter

how firm these may be; but he should support them, in the course of the operation, by a ligature, held on the inside of the mouth by the fore-finger of the left hand. We do not approve of the precaution which most dentists seem to regard as so necessary, that is, to rinse the mouth after each stroke of the file, for the purpose of getting rid of the calcareous particles removed from the tooth by the file; for we regard this enamelled dust as an agent which not only assists the action of the file, but renders it less rough and unpleasant.

In filing a tooth for any cause, care should be taken to protect those adjoining, and also the healthy parts of that upon which the operation is performed; for this purpose, files should be obtained, of various size and form, cut on three sides only, that is, on one side and both edges; the safe side should be placed against the tooth which it is desirable to spare. There is another precaution which it is indispensable to observe: the part of the file which is not brought into service should be covered with linen, in order to save the commissures of the lips; this is especially necessary when the teeth in the back part of the mouth are operated upon, and the file-carrier is dispensed with.

In order to perform the various operations upon the teeth which are accomplished by means of the file, this instrument should be made of fine, well tempered steel; the teeth of the instrument should be sharp and cut regularly, for if they are irregular and widely separated, the shock they produce, when used, is painful and often insupportable to the patient. In some cases, an operation commenced with one file, is completed with another; the dentist should, therefore, have at hand a number, of various sizes and forms, and also several file-carriers, both straight and curved, so that he may be able to select any which accidentally become necessary. When the teeth are very hard, it sometimes becomes necessary, in order to obtain more power, particularly when the molars are the subjects of the operation, to fix the fragment of a file, protected by a piece of linen or paper, in a pair of forceps. It is in such cases as these, particularly, that the file should not be cleaned during the operation, as the detritus augments its action.

Guided by these general rules, the dentist, if he finds it necessary to operate upon the back teeth of the upper jaw, places himself behind and on the right side of his patient, if the teeth to be operated upon are on this side, and on the left if the contrary is the case; he inclines the head in the opposite direction, uses the fore-finger of the left hand to raise the lip, and, in order to obtain more power, grasps the file with his whole hand.

If, however, the front teeth are operated upon, the head is simply inclined backward, and the file is held, according to circumstances, with the whole hand, or with three fingers only, after the manner we shall presently describe.

If the lower teeth are to be operated upon, the dentist places himself, on the contrary, in front of the patient, depresses the lip with the fore and middle fingers, the thumb always taking a solid point of support under the chin; the process is then the same as that followed in the upper jaw. When the front teeth of the lower jaw are operated upon, the head should be inclined slightly forward.

Let us now examine into the various cases which require the use of the file; but first establishing, as an invariable precept, that the file should always be used gently and lightly, every thing like a jerking movement being carefully avoided; the operation will always have been performed with sufficient rapidity, if it is accomplished without loosening the teeth and irritating their vital parts.

1. The most common of all circumstances in which the file is used, is in the commencement of caries. If this has affected one of the sides of a tooth, a careful examination should be made to ascertain whether it has been communicated to the adjoining tooth; and, to ascertain this with certainty, the two teeth should be separated. If the adjoining tooth is discovered to be perfectly sound, a file, cutting on one side only, should be employed to remove the decay from the affected tooth; in using the file for this purpose, if the affected tooth is in front and above, it should be supported by applying the thumb upon the gum; the movements of the instrument should always be made with great regularity. If both adjoining teeth should be found affected, a file cut on both sides and both edges should be used.

If the decay is superficial, it should be entirely removed ; if it be not painful, the file should be used rather too much than too little. Let us speak more explicitly : if the caries have not, for instance, destroyed more than one-fourth of the tooth, it should be filed parallel to its longest diameter, until the decayed cavity is entirely removed, and the surface of the tooth found to be perfectly smooth ; it must not be forgotten, however, that the filing should be done, as much as possible, at the expense of the internal face of the tooth, so that the portion which is apparent may be spared. But if the decay has extended more deeply than one-fourth the tooth, it is our opinion that, to remove this, it is imprudent to file away the healthy bone above and below the decayed portion. In doing this, a space is made which is almost equivalent to the loss of the tooth ; it would have been well if this had been thought of by M. Lefoulon, who gives the dangerous advice, in relation to this subject, to destroy *a third, or even one-half of the tooth*.^{*} In cases where the decay has penetrated more deeply, it is necessary, after having, of course, isolated the affected tooth, to use a half-round file, in order to reach directly the decayed part, and avoid filing the tooth in its whole length. If, however, after having effaced this cavity, the bone of the tooth at this part still remains black, and the bony part is sufficiently thick to permit the removal of this portion, without reaching the dental canal, the file should be used until the spot is effaced. But, if the caries has penetrated the tooth as far as the canal, it will simply be necessary to separate it from the adjoining one, file the decayed part as much as possible without weakening the tooth too much, and then, after detaching, carefully, all the soft, blackish parts, to cauterize, and, if the pain do not prevent, to plug it.

All authors recommend, besides, as an important rule, that when a tooth is filed on the side, a *portion near the gum should be left untouched*, that is, a shoulder of bone should be allowed to remain, in order that the space made may not close up again, which would, otherwise, infallibly be the case. This precept is erroneous, and for two reasons : the front teeth, which seem

^{*} Ouvrage cite, p. 245.

particularly to be the subjects of this rule, have, in general, the form of a pyramid, the base of which is toward the crown, and the apex toward the root, so that the line separating the portion filed away from that which is to remain, even if one-third were removed, would almost always fall outside of the neck; and, secondly, even admitting that enough has been removed from the tooth to approach the point of contact with the alveolus, it would certainly be much better to take measures to bring the separated teeth together again, as a space in the dental arch, especially in front, is always unsightly, and interferes with the pronunciation. We have often been called upon to make substitutes for teeth which had been filed in this manner, so as to leave remaining only a half or a third of their substance, producing a deformity so very unpleasant and inconvenient, that the persons proposed sacrificing them entirely. The precept, therefore, cannot be carried into practice, and, even if it could, it would lead to injurious consequences.

The use of the file, for the removal of caries from the lateral surfaces of the incisor and canine teeth, requires the greatest care. Used imprudently, it may occasion great loss of substance, by removing the sound and healthy with the diseased portion, and however oblique the direction given to it may be, it is always liable to act upon the whole surface of the tooth, without removing all the caries, thus failing to remove the disease, and to accomplish the end proposed by the operation. To obviate this inconvenience, files bent in form of an arch, are sometimes used, and also rose-head drills, a species of file, which can be brought to bear directly upon the principal seat of the caries.

Until lately the drills were simply fixed at the end of a long slender shaft, and rotated rapidly by means of the fingers or by means of a drill-bow. But in this last case, fixed invariably to the end of the shaft upon which works the drill-bow, it can only be brought to bear upon the anterior surface of the front teeth. Some years ago it was believed that an invention had been made which brought to perfection the apparatus upon which these drills were fixed, by arranging them in such a manner that they could be either fixed directly at the end of

the principal shaft or obliquely to it; in this second direction the drill receives its rotatory motion through the principal shaft by means of two cog-wheels, which work at an angle with each other. One of these wheels is set in the principal shaft, and the other in the secondary shaft which receives the drill. Implanting this secondary shaft on either side of the principal cog-wheel two different combinations are obtained, so that, by this arrangement, the caries, in both its diverse positions, may be reached. In one of these positions, the drill acts precisely as when placed at the end of the simple shaft; in the other position, it inclines toward the hand of the operator in such a manner that it is brought to bear directly upon the internal surfaces of the canine and incisor teeth.

Without denying that this is a very ingenious instrument, we persist in preferring the common drills, particularly those which are fixed at the end of a straight handle, and are rotated by the fingers; there is scarcely any situation in which the caries cannot be reached with this instrument, and it has the advantages of being entirely under the control of the hand, and of being less complicated, and less formidable to the patient.

Instead of having recourse to the file, some dentists prefer scraping out the decayed part with excavators, curved into various forms, and well tempered. By means of these instruments they cut away as much of the tooth as they deem necessary, from the inner part, preserving the external plate of the enamel. This method may have the advantage of attacking the decayed portion more directly; but, whatever M. Delabarre may urge in its favor, it has the objection of increasing the cavity, thus favoring the accumulation of alimentary substances and saliva, if it is not plugged, whilst the file, which in most cases tends to level the surfaces, removes with certainty the decay, by means of the loss of substance which it ordinarily effects in the parts in the middle of which the cavity was situated.

2nd. Finally, when it is necessary to have recourse to the file for the purpose of levelling teeth which are too long, preparing roots for the reception of artificial teeth or removing prominences of roots, which wound the adjacent parts, half round, triangular, or flat files, according to the case, are used. If the

situation prevents the use of the file transversely, it should be directed obliquely, thus cutting away the desired portion in parts and in various directions. Care should also be taken to avoid filing in an equal and uniform manner, as the operation will be rendered by this means, more protracted and painful; little prominences, should, as much as possible, be formed, because these enable the file to act more effectually; large portions are cut away and the operation performed more promptly.

This method of shortening the teeth can be resorted to in those cases only when they exceed the others in length but very little; but, in cases of quite common occurrence when the projection is very considerable, as often occurs with those which have lost their antagonists, or when we wish to remove the entire crown, in order to substitute for it an artificial one, the following process should be followed. The tooth to be operated upon should be held, firmly, between the thumb and finger till a furrow can be filed as close to the gum as possible, on both sides of the neck, and in front, the edges of a pair of cutting forceps should then be placed in the furrow, and the tooth excised by a steady and firm pressure. The furrow, which we have directed to be made previously to using the cutting forceps, has a two-fold advantage, it assists the cutting action of the forceps, prevents them from slipping, and the tooth from cracking, as will hereafter be seen. When the file approaches the centre of the tooth, pain of the most insupportable kind is often produced; if the situation of the tooth permits, it is necessary, then, to file from the opposite side as near as possible to the centre. If the pain is so great as to prevent the completion of the operation with the file, the remaining portion should be cut away by means of the forceps, the nerve cauterized, and the asperities of the root cut down with a fine file.

Before performing the operation for reducing a tooth in length, it is necessary to ascertain whether the dental pulp will be reached; in young subjects great caution should be observed to guard against this disaster, for the pulp is then of considerable size, and cannot, without great inconvenience, support the operation of filing. For this reason, recourse should not be had to this operation without it is absolutely necessary. It is some-

times important to file the milk teeth, when decayed, in order to preserve them, and some dentists, amongst others, Fauchard, have seen infants with teeth so large, a short time after their birth, that it has been indispensable to file down their points, because they wounded the breast of the nurse. Some practitioners are of the opinion that in this latter case it would be better to wean the infant or to extract the precocious tooth. We are not of this opinion, for the weaning of an infant is too serious a matter to be admissible when it can be avoided,* and the extraction of a tooth at this age may cause the loss or removal of the germ of the secondary tooth which is, at this time, in close connexion with that which precedes it. M. Oudet has communicated to the Academy, a case in which, in extracting a small molar for an infant, the follicle of the secondary bicuspid, which was situated loosely among its roots, was also brought away; it was already covered with the external tubercle of its crown.† For the reason it has been established, as a general rule, that the first teeth should never be extracted till those of the second set are ossified and situated in distinct sockets. If called in to a case of the kind, to which we have above alluded, we should not hesitate to file or even excise the offending tooth.

Whatever may be the cause for which it is found necessary to perform the operation of filing, and whatever may be the skill of the dentist and the quality of his files, it often occurs that he is not able to complete the operation at a single sitting, without great discomforts to his patient, such as setting the teeth on edge, local pain and at the same time a general irritation which manifests itself by a nervous agitation and a buzzing sensation in the head. This, however, should not be sufficient to cause him to give up the performance of the operation, but it is well, under such circumstances, to defer it and accomplish in several sittings what cannot be done at once, and it should never be forgotten that

* On this subject, the premature weaning of an infant, we find a very ingenious letter of Professor Trousseau in the February number of the *Journal de Medicine*, for 1843.

† See the *Bulletins de l'Academie Royale de Medicine*.

in such cases, as in all others, no trace of the passage of the file should be left. To effect this, after a rapidly cutting file, finer ones should be used, until the filed surface, as nearly as possible, presents its primitive smoothness. We think, however, the advice given by M. Begin,* and many other surgeons, may be dispensed with ; that is, to rub the filed parts with a piece of hard smooth wood, so as in a manner to burnish it and restore the polish of the enamel and bony portion.

It sometimes occurs in the course of the operation, that the file gets fixed between the teeth ; it is best then to stop and gently disengage the instruments, for in getting it out too hastily there is a risk of breaking away portions of the enamel. This is an accident, too, which occurs sometimes with dentists whose hand has not yet acquired, by practice, the necessary steadiness and firmness.

Such are the general circumstances, under which the teeth are filed, and the rules according to which this operation should be practised. Performed with skill at the proper time, it offers precious remedy, too often neglected, of preserving the teeth from decay and arresting its progress after it has commenced, and also to restore their natural solidity to such teeth as have been loosened in consequence of their disproportionate length ; but when it is performed without discernment, and in disregard of the indications, which we have pointed out, its consequences are grievous and become an infallible cause of ruin to the parts to which it has been applied. That this is true, daily observation, unfortunately, proves.

SEC. 2—*Cauterization of the Teeth.*

Applied to dental surgery, the object of the operation of cauterization, is to destroy the nerve and the pulp, for the purpose of appeasing obstinate tooth-ache ; of drying momentarily caries more or less deep, of a sanious character, to arrest alveolar hæmorrhage, and to prevent the reproduction of fungous tumors, springing from the bottom of the alveoli, or from the surface of the gums.

* *Dictionnaire de Médecine et Chirurgie Pratiques*, t. 6, p. 197.

This operation is generally performed in two ways, with a heated instrument, or with caustics. The former which constitutes the *actual cautery* is that which is most generally practised; in some cases, however, its application is not sufficient to relieve pain, and it is sometimes observed to augment it, when the case is such that it cannot be conveniently applied. The same remark holds good with regard to its use against caries, although it is often effective in arresting its progress and drying it up; at other times, in consequence of its disorganizing action, it renders the affected teeth more brittle and lessens the chance of their durability. Nevertheless the promptitude and energy with which it acts, compensates, most generally, for its inconvenience, and cause it to be regarded, with good reason, as a remedy which, in certain circumstances, is of great value.

Applied for the cure of odontalgia, the actual cautery has been recommended by Hippocrates; but as is very properly remarked, by M. Duval, it is not certainly known whether in imitation of the Egyptians, he advised its application to the tooth itself or to the gums or temples, as is supposed by Professor Alpin;* or whether he employed it as the Japanese who, according to Ten-Rhyne,† cauterized the nerve at the mental foramen.

Whatever may have been the opinion of Hippocrates, with regard to this subject, the destruction of the dental nerve by the actual cautery is effected by means of an instrument of the following description, heated to a white red: the cauterizing instrument is a simple steel stylet about two or three inches in length, with an oval enlargement some eight or ten lines from its extremity, to retain the caloric in order to prevent it from growing cold too rapidly; it is fixed in a handle. Some dentists prefer to have this bulb movable so that it may be adjusted to suit every variety of case; but we think it better that this bulb should make one with the shaft of the instrument, as its caloric will then be more rapidly communicated. If fixed, the best distance seems to be about an inch from the extremity of the shaft, so that the portion of the instrument, which is imme-

* *De Medicina Ægyptiorum*, lib. 3, cap. 12.

† *Dissertation de Arthride et Mantissa Schematica de Acupunctura*.

diately applied, may have sufficient length to answer in every possible case ; as, for instance, when it is used to cauterize the branch of the artery at the bottom of an alveolus, to arrest hæmorrhage. For ourself we prefer, for this purpose, a simple iron wire bent upon itself, which, in consequence of flexibility, is not liable to break in the dental canal in consequence of the sudden movements which patients sometimes make, under the pain attendant upon the operation. As to the bulb we regard it as useless ; as the operation is very painful and it should be performed with all possible rapidity, and the simple instrument, properly heated, will always contain enough caloric to effect the intended purpose.

If one of the incisors or canine teeth of the lower jaw is to be cauterized, the operator places himself on the right side and a little in front of the patient ; he separates the lips with the index and middle finger of the left hand, and supports the jaw with his thumb placed under the chin ; then holding the heated instrument, in this case curved, in his right hand, he introduces it with rapidity deeply into the dental canal, makes with it two or three rotary movements and withdraws it. If one of the small molars is to be cauterized, the operator places himself on the same side with the tooth, which is to be the subject of the operation, the lips, as in the former case, are to be separated by means of the index and middle finger ; but the thumb is now placed under the angle of the jaw ; the operation is then performed in the manner just described. Some dentists, in order to protect the lips and tongue from injury, make use of a species of large spatula, adapted especially to this purpose, but this instrument seems to us to be useless, as in all cases where any thing of the kind is necessary, the handle of the small mirror, used in the mouth, answers quite well, as a substitute. It is to be observed, here, however, that, as the small molars have two roots, it is indispensably necessary to pass the instrument down into both. As to the large molars, they are never destined to receive pivots, and, as they are provided with three or four roots, it is difficult to reach the nerve in all of them, they are, therefore, cauterized with an instrument enlarged at the extremity sufficiently to destroy at once the whole body of the pulp in the crown.

The application of the actual cautery to the teeth of the superior jaw differs, somewhat, from the process just described. The operator places himself in front, and a little on one side, raising the superior lip with the index finger of the left hand, the thumb resting upon the teeth in the vicinity; the lower lip is depressed by means of the middle finger of the right hand; the instrument, which should be straight and not curved, as it is when used for the lower teeth, is guided by the index finger and the thumb.

Thus far we have considered cauterization only in its application for the purpose of destroying the dental pulp; when recourse is had to this extreme remedy for the purpose of arresting the progress of a deep caries a different process is adopted. The asperities of the edges of the cavity are first removed by means of the file or cutting forceps; then with an instrument slightly curved, and cutting at its extremity, or which answers a better purpose, a curved scraper, all the soft parts should be removed from the cavity, which must be dried out with a lock of cotton; the cauterizing instrument is then introduced with caution and touched against the diseased part; in order to burn it to a proper depth, the instrument, according to the extent of the caries, and the sensibility of the tooth, should be introduced into the cavity two or even three times.

The instruments used for this purpose, are not of the same character as those intended for cauterizing the nerve, but are species of pluggers formed of a metallic shaft more or less curved, at the extremity, which has generally an oval form, and is furnished with a surface which gives a place of support to the finger, so as to allow it to be pressed firmly. It is useful in this species of cauterizing instrument, to have it provided with a bulb, which we condemned in the stylet for destroying the nerve, for, in the case for which this is used, it is necessary that the heat should be retained longer. It may be remarked, here, that the hand by which the instrument is held, should be protected by a towel. We give the preference to cauterizing instruments such as we have just described, to those fixed in a handle, because they are firmer and because the cement, which fixes the latter in the handle, is melted by the heat.

These instruments sometimes used to arrest humid erosions of a certain character, which resemble an efflorescence of the enamel; but in such cases they act only in drying, not cauterizing, the diseased portion; to accomplish this object, the instrument when heated red is brought near, without touching the enamel, but if it be brought so near as to touch, it should be but slightly heated, and brought in contact with the enamel several times, as it is necessary to use great caution to avoid the disaster of causing the substance to crack.

Cauterizing instruments are generally heated in a small furnace, when they are large; in a candle, or, what is better still, in the flame of a spirit lamp, when they are small.

But, however cautious we may be in counteracting these preparations, there are many persons, and especially females, who cannot make up their minds to allow a red hot instrument to be applied to their teeth. In such cases, recourse must be had to caustics, (potential cautery.) These caustics are either solid or liquid. The nitrate of silver, combined in equal proportions, with the acetate of lead, and caustic potash, form the first class. This species of caustics is used by introducing into the cavity of the tooth, by means of a large slender pair of spring forceps, a very small portion, which is covered with cotton and allowed to remain till the desired effect is produced, when it is removed. The liquid caustics are, in general, ammonia, the nitric and sulphuric acids, and also the butter, or chlorine of antimony, which, in consequence of its oleaginous nature, belongs rather to the liquids than the solids; a small lock of cotton is touched to the caustic, introduced with a stylet, and covered with cotton or a little wax.

A dentist of Nancy, M. Turck, has proposed a very ingenious method for the use of concentrated acids, in cauterizing the teeth. This is a small glass tube, about one-third of an inch in diameter, with one of the extremities terminating in a bulb, and the other in a capillary tube. When the bulb at one extremity is held in the hand, the air which is contained in it expands, and a portion is expelled; the capillary extremity is then inserted into the acid, which is to be used, and as soon as the air in the tube, becoming cold, contracts, a vacuum forms,

which is filled by the acid. When the instrument is thus charged, the extremity is applied to the point to be cauterized, the bulb is held in the hand, and as the air becomes again heated and expands, the liquid is forced out.

This, we repeat, is a very ingenious instrument, but it has two great objections : in the first place, it is too fragile, and is, therefore, liable to be broken in the mouth of the patient, by some of the sudden movements which are instinctively made when pain is experienced ; and, besides, it may be readily supposed that it would be impossible to make any calculation of the exact quantity of acid which would be forced out ; consequently, far from adopting the opinion of M. Malgaigne,* who speaks of it as the most certain method of cauterizing the teeth of the lower jaw, we regard it rather as an amusing philosophical toy, than an instrument occupying an important rank amongst those the assistance of which we should rationally invoke.

The dangers to which not only the osseous tissues of the teeth to which these caustics are applied, but also the parts adjacent to them, which it is difficult to protect, should render the operator very circumspect in their use ; perhaps it would be well to discard them entirely. Besides, it is very inconvenient to apply them to the teeth of the upper jaw, from which they have always a tendency to escape, in consequence of their gravity, no matter how favorable the cavities in which they are placed may be. Another unpleasant result which we have observed to follow the use of caustics is, that when they fail entirely to destroy the dental pulp, it becomes the seat of fungous tumors, which may put on a cancerous character.

We think that the cauterization of the teeth, either by means of the actual or potential cautery, is an extreme remedy, especially when it is resorted to for the purpose of destroying the sensibility of a painful tooth. Many dentists, with reason, maintain that it is better, at first, to attempt the accomplishment of this object by the use of the essential oils, or concentrated alcoholic tinctures, such as those of cinnamon, mint and cloves, to which may be added ether, balsam of tolu, extract of opium,

* *Manuel de Médecine Opératoire*, page 108.

myrrh, incense, and many other substances, of the efficacy of which we have spoken, explained the mode of action, and developed the various methods of application, in the pathological part of this work, especially in the portion devoted to caries.

SEC. 3.—*The Obliteration or Plugging* of the Teeth.*

We have seen that the operations of filing and cauterization of the teeth had each its peculiar advantages, and had, for their common object, the arrest of the progress of caries. But, from a very little reflection upon the methods of practising these operations, it will be seen that, far from obviating the effects of caries, they only render these effects more apparent, for, no matter how skilfully they may be executed, they always augment the amount of lost substance of the affected tooth. It is not surprising, then, that a desire should have existed to obliterate the cavity which these operations cannot efface, as much for the purpose of preventing the lodgment and retention, in it, of food and saliva, and the action of the atmosphere, as to restore to the teeth their natural usefulness.

Under the generic expression of plugging, the operation having for its object this obliteration, is designated. For this purpose, lead, in leaves, was formerly exclusively used, for which has now been substituted, tin, silver, gold and platina, which is used, like the lead, in leaves; and, lately, a compound, known by the name of the inventor, as Darcet's mineral, of which we will presently speak more fully. We will notice, also, the various attempts which have lately been made to effect the object proposed by the operation, in the most convenient manner

The time at which this operation was first practiced, as also the name of the person who first performed it, is not known. Some erudite persons have given Celsus that honor; but what this author says with regard to the operation, proves, simply, that he advised the filling of a decayed tooth with lead, in order

* The French word used to designate this operation, and which we have not thought proper to translate literally, is *plombage*, (*leading*.) T.

to enable it to bear the pressure necessary to effect its extraction, and not for the purpose of accomplishing what is generally proposed at the present day. The following is a literal translation of the expressions he makes use of: "But if the tooth is much decayed, it is necessary, first, to fill the cavity with lint or lead, well packed in, so that it will not break under the forceps."*

The best conditions in which a cavity, requiring plugging, can be, is not only to be free from pain, but insensible to the action of heat and cold, to the contact of hard bodies, and the pressure of particles of food; it is better that it should not be the seat of a discharge of any kind, and the cavity should be sufficiently anfractuous to retain the metal after it is inserted, as this would soon escape from a cavity shaped like a funnel, with the base looking towards the crown, especially if the tooth were situated in the upper jaw. These three fundamental conditions, insensibility of the tooth, absence of any discharge, and anfractuosity of the cavity, are not absolutely essential; for we daily succeed in relieving odontalgia, by the obliteration of the cavity which is the seat of pain, thus preventing the contact of the air, the saliva, and particles of food; in putting a stop to a discharge, by arresting the work of disorganization, which is the cause of it; and, finally, in cases where the cavity is not of a suitable form to retain the metal used, we make it so with the proper instruments.

Maury has committed a great error in laying down, as a general rule,† that a tooth should be plugged "*whenever it is decayed or painful*;" for there are cases in which it would be impossible for the patient to bear the slightest pressure in the painful cavity, and, if this is the case, how much more difficult would it be to bear the introduction of a foreign body. If Maury has committed an error in setting down this general rule, M. Malgaigne is not nearer the truth, when he gives the following directly opposite advice:‡ "*Painful teeth should never be plug-*

* *Ac si exesus est (dens) ante id foramen vel linamento vel bene accommodato plombo replendum est, ne sub forcipe confringantur. De re medica, liber vii, caput iii, sectio v.*

† *Ouvrage cite, p. 249.*

‡ *Manuel de Medicine Operatoire, p. 109.*

ged. Both are wrong not to establish at the same time the rule and the exception, as there is danger by expressing themselves in such unqualified terms to lead beginners into an injurious practice. M. Malgaigne, vainly rests for support upon the opinion of Duval, who expresses himself, with regard to this subject, as follows: "*As a general rule a tooth should never be plugged except when it is entirely free from pain and insensible to pressure of any kind;*" it is not on account of this opinion, the less demonstrated, that a great number of persons only cease to suffer pain from their teeth when the decayed parts have been protected from the action of the atmosphere, the pressure of particles of food, &c.

All attempts to plug a tooth should be preceded by an examination sufficiently careful to enable the dentist to obtain an exact knowledge of its vital and physical condition. For this purpose a sound is used; this is a species of simple metallic shaft, generally straight, but sometimes curved. When it is found, after this examination, that nothing contra-indicates the operation, (that is, we repeat, when the cavity is not so tender as to give room to believe that it would be unable to bear the pressure of a foreign body, and the pressure necessary to effect its introduction, and when the opening of the cavity is not larger than its interior is, or can be made,) it is to be cleaned out in accordance with the rules we have described; then, after having dried it out by the successive introduction of pledgets of cotton, an effort should be made to form some asperities capable of readily retaining the metal. We would observe here that, in the mouths of some individuals when we are operating upon the lower jaw, the saliva flows in such abundance that it completely fills the cavity, the moment the cotton which is used to dry it out, is removed, and consequently prevents the operation, for dryness of the cavity of decay is indispensable. In cases where it is impossible to operate with sufficient rapidity to avoid this obstacle, the lips and gums should be covered with a layer of cotton which will absorb the saliva as rapidly as it presents itself.

After having taken these preliminary steps, let us suppose the operator is about to make use of any of the metals, in the form

of leaves; a portion of one of these should be torn off and rolled between the fingers, so as to bear some proportion to the cavity to be stopped, but always larger. Putting himself in a convenient position, he places the finger of his left hand at the opening of the cavity, whilst, with a small sized, blunt pointed plugger, he forces in the metal. Then taking an instrument of larger size he again presses upon the metal, brings it to bear upon all points, in a manner perfectly to fill the cavity; finally, after having removed all the inequalities it may present around the circumference of the cavity, it is polished with a burnisher.

Although a matter of pure detail, it will be well to observe, here, that it is better to take rather more than less of the metal necessary to fill the cavity, so that new portions will not have to be added to that first introduced, for these always adhere with difficulty. Sometimes, however, it is a good practice to pierce the whole filling in the centre, for the purpose of adding a small portion, which, on being forced in, acts upon that first introduced, in the manner of a wedge. As to the advice given by some dentists, as an undeviating rule, when the cavity is in the grinding surface of the crown, to raise the plug above the edge of the cavity, so that it may be forced down in the act of mastication, we formally disapprove of it, because the operation of plugging should be performed by the dentist himself, and it is ridiculous to depend upon an unequal pressure, to complete it, which it often does to the detriment of the correspondent tooth, upon which is imposed this task.

Simple good sense will indicate that it is quite difficult to perform this operation when the decay is situated between teeth locked closely together, when that cavity is on the posterior surface of a large molar near to another tooth, and so far back that the commissure of the lips prevents the free use of instruments; it may be accomplished, however, with the aid of skill and patience, and by repeated attempts, after it has been separated from the adjoining tooth, by means of the file.

The fear of exerting a pressure upon the nerve, which would be productive of pain, has induced M. Delabarre to advise the application of a little concave plate of gold to the bottom of the cavity, before the metal is introduced, so that the filling may

rest upon it as upon a floor. This precaution appears to us to be at least a superfluous complication, for, if the little plate used, is thick, it fills the cavity too much, and adapts itself badly to the bottom, and if it is there, it yields to the pressure and fails entirely to effect the purpose in view.

The process we have described is applicable to all the metals which are used in leaves; but it is not a matter of indifference which of these metals is used for the purpose of plugging decayed teeth. Lead, which was formerly, almost exclusively, used, is almost entirely abandoned now, because it soon oxydizes, and, consequently, quickly becoming black, it imparts this hue to the teeth filled with it; silver has the same objection. Tin, platina, and still better, gold, are now used in preference to any other metals; * gold answers particularly well for filling cavities near the anterior part of the mouth, not only because it is not liable to oxydize, but because its color approaches nearer to that of the teeth than any other metal. But the metallic compound, which is known as Darcet's mineral, is more used at the present day than any of the metals which we have named. It is composed of eight parts of bismuth, five of *lead*, and three of *tin*, and this compound is rendered more fusible by the addition of a tenth of mercury; but this addition, to say the least, we regard as useless, first, because the preparation compounded according to M. Darcet's receipt is sufficiently fusible, and because the mercury has the effect of turning black sets of artificial teeth in the mouth, as, also, the teeth which are filled with it.

This metallic compound has the immense advantage of fusing at a temperature below 100 degrees, (Centigrade;) it is not used in leaves, as the other metals we have mentioned, but in little ingots. It is used in the following manner: after having cleaned out and dried with cotton, the cavity to be filled, so that no humidity is left, which, dilating under the influence of the caloric, would prevent the metal from running into all the anfractuositities of the cavity. Some pieces of the metal, more

* Some modern dentists have claimed for themselves the merit of having first used gold for filling teeth; but this is not true, for Fauchard formally makes mention of this metal. See his third edition of 1785, tome 2, p. 68.

than sufficient to fill it, are put into the cavity ; the cauterizing instrument is then held in the flame of a candle, or lamp, till it receives heat enough to be felt when the finger is brought close to it ; it is then applied to the metal, which immediately melts and runs into all the sinuosities of the excavation, where it is pressed lightly in every direction, by the finger, until it hardens ; then it is polished with the cauterizing instrument whilst it still remains warm. This metal, as will be readily perceived, accommodates itself better than any other to the different forms of the dental cavities ; it is only to be regretted that its grey metallic color contrasts with the natural color of the teeth, that it can only be used for the lower teeth, and particularly when the cavities are upon the grinding surfaces of the larger molars ; besides these objections there are many persons who cannot be made sensible of its manner of fusion, and who become alarmed at the necessary preparation of heating the instrument, expecting it to produce pain, which we will say, *en passant*, is frequently quite acute.

It is desirable then to find a mastic which combines the advantage of the color, durability, and solidity of the metals which are preferred. Did the ancients know of any substance combining these several conditions ? Of this we are entirely ignorant, and, in spite of all our researches, we have discovered nothing upon which Laforgue bases his assertion,* *that this substance exists in many of the insular colonies of the Pacific Ocean, among the savages of Canada, and the Bedouins of Africa.* The species of cements with an alumine base recently proposed by some members of our profession, are far from attaining the desired end, as we have already observed ; they can hardly be used, except in cases where it is desirable to ascertain by a preparatory operation, whether the presence of a foreign body will produce pain in a decayed tooth, or will renew that which has been suspended.

It was for the purpose of attaining this end, that M. Taveaut† has proposed to fill the tooth, temporarily, with a little cotton,

* *Séméiologie Buccale et Buccamancie*, p. 83.

† See the *Gazette des Hôpitaux*, of the 2d and 5th of May, 1840.

dipped in a solution of resin of the *pistacia lentiscus*, or simply in benzoin, dissolved in alcohol at forty-two degrees. This substance, prepared in the manner here directed, would serve equally as a palliative remedy, such as opium, camphor, myrrh, &c., which it may be desirable to retain in the bottom of the cavity for a time, and it can be removed at pleasure. A cement, very similar in character, has been recommended by M. O. Henry, who gave the following directions for its preparation: Make a saturated solution of mastic in tears, in sulphuric ether, and decant it after it has macerated several days; it is used by dipping into it a little pledget of cotton, equal in size to the decayed cavity; the cotton immediately agglutinates, and fills the cavity.*

We have, for a long time, indulged the hope of discovering a substance of greater hardness than those of which we have been speaking. We have principally devoted our efforts to the *fluates*, which, as is known, have the property of hardening when exposed to humidity; but, up to the present time at least, they have not come up to our expectations; the great obstacle is the variable nature of the salivary and buccal fluids, which, from alkaline become so promptly acid, and *vice versa*. The following compound shows, however, we were, at least, in the right track: equal parts of siliciate or fluoate of lime and alumine, dried and pulverized, with a sufficient quantity of water to form it into a homogeneous paste; this is introduced into the cavity, and its desiccation, favored by the approach of a heated instrument.

M. Taveau has also proposed, for the permanent plugging of teeth, a substance which he calls *silver paste*, and which another dentist has attempted to bring into general use, under the very insignificant title of *mineral succedaneum*. This preparation is made by saturating virgin silver, reduced to a very fine powder and well refined, with a given quantity of mercury; this compound is ground in a mortar, until the metals are well incorporated with each other, when it is pressed in a piece of kid skin, deprived of its epidermis, for the purpose of extracting as much

* Foy: *Formulaire Med. Prat.*, 4th edition, p. 184.

as possible of the mercury, which escapes from the skin in little drops. The residue obtained is a paste sufficiently firm, but also quite manageable; it may be kept, for use, in a glass bottle, stopped with emery.

"This preparation," says M. Taveau, "is used cold, and is introduced into the cavity of the tooth with a plugging instrument, precisely in the same manner as the metals in leaves. The mercury volatilizes, in consequence of the heat of the mouth, and, in the short space of three or four days, the silver remains in a single piece, which fills all the anfractuosités of the cavity as perfectly as if it had been melted and poured into it." This new method of plugging teeth, in the opinion of the inventor, has a great superiority over most of those which are commonly used at the present time; because it does not require the employment of heat, as is the case with Darcet's mineral; because it adapts itself better to the irregularities of the bottom of the cavity than the metals used in leaves; and, finally, because, as it does not harden immediately, it can be removed if it is discovered, after being introduced, that the tooth was not in a condition to be plugged permanently.

This substance, to give to it its real value, and judge of it without prejudice, has these objections: it is of a dull grey color, which presents a very disagreeable aspect; it communicates to the tooth filled with it a blackish hue, which renders it entirely unfit for the front teeth, and, in consequence of the evaporation of the mercury, which always continues, even after it has acquired its greatest hardness, exerts an injurious influence upon any artificial teeth contained in the mouth; an objection which we have also urged against Darcet's mineral. The objection last mentioned seems to be well founded, from the fact which we have observed, that persons employed in manufactories where mercury is used, wearing artificial teeth, find it necessary to have them frequently repaired. The objections, we have stated above, may be urged against the fusible metal which is generally employed; but one property of this paste, if it do not altogether proscribe it, should, at least, circumscribe its use; it is this: if the tooth should become painful after this substance has perfectly hardened, the removal of the filling requires very painful, and often useless efforts.

When a tooth is well plugged, it is absolutely impossible for the saliva or air to penetrate the material with which the cavity is filled, and the tooth may, consequently, be preserved for a long time without undergoing any change. But no matter with how much care and skill the operation may have been performed, it is by no means certain that the pain which accompanied the formation of the cavity may not return; and it often does return with much acuteness, and is sometimes followed by inflammation and abscess. In many cases such results are successfully combatted, and the unpleasant symptoms made to disappear permanently, but very often, also, it becomes necessary to remove the filling from the tooth and to leave it in this condition until all signs of irritation have passed away, and no discharge from the cavity remains. A second attempt should then be made to plug it, but the precaution should be observed to press so lightly upon the metal that it may be removed in case it become necessary, without much difficulty; this is effected by means of a common excavator, when the cavity has been filled with any of the metals in leaves, and with a heated cauterizing instrument of Darcet's mineral, have been used.

The unfavorable results which sometimes follow this operation, has induced some practitioners to give the advice, never to plug a tooth, at once permanently. Instead of doing so, they advise the operator, at first, to press the gold only hard enough to exclude food and moisture, and, after some days have elapsed, to press it more firmly, and when the sensibility of the tooth has entirely passed away, to empty the cavity, and refill it perfectly. This precaution may answer very well for tyros, but the experienced practitioner will generally know, at once, upon examining a tooth, whether any unfavorable results will follow a permanent operation, and will not find it necessary to adopt this temporary filling as a general rule.

Finally, in cases where a decayed tooth is so very sensitive as to be unable to bear the pressure of a hard body, but which is injured by contact with the air, and particles of food, we would simply advise the cavity to be filled every day with cotton, which may be saturated with cologne, or something of that nature, if the sensibility of the tooth should not prevent it; but

at some subsequent period recourse should be had to a permanent operation.

SEC. 3.—*Luxation of the Teeth.*

By the luxation of a tooth is to be understood its displacement from its natural situation, by drawing or moving it sufficiently to rupture the vessels and nerves which penetrate the central cavity, at the extremity of the roots, without removing it entirely from its socket. After it is thus displaced it is forced back into its original position, by means of suitable pressure upon the crown.

This operation, one of the most painful of those common to dental surgery, was formerly very frequently performed for the arrest of very superficial caries, and to give relief in cases where a tooth was painful without being externally diseased. Some contended that the luxation need not be complete, whilst others maintained the contrary; all however were agreed upon this point, that the end proposed by the operation was only attained when the nervo-vascular chord, which penetrates the tooth, was ruptured. Dentists who are familiar with all the circumstances attendant upon the operation of the extraction of a tooth will be aware that they should always so control their efforts as to stop at a given point, and to ascertain with certainty when the dental chord is broken; it is necessary, as Laforgue* has very properly remarked, to move it upon its axis till an acute angle of sixty degrees with the edge of the alveolus is formed.

Now, in such case, one of two things may happen, either the tooth will be completely removed from its socket, which, of course, is more than was designed to be accomplished, or the desired rupture of the vessels and nerves has been incomplete; when this occurs, inflammation and pain of such a character ensue as to render the extraction of the affected tooth necessary, and to cause regret that it had not been done at once.

But admitting that the sweeping movement given to the tooth

* *Theoric et Pratique de l'Art du Dentiste*, p. 121.

is guarded enough to avoid its complete extraction, and quite sufficient to rupture the dental chord, it is not always certain that the alveolar process may not be fractured. On the contrary, as will be seen in the following paragraph, fracture occurs in the majority of cases, and the fragments produced by it, however small they may be, invariably cause irritation and inflammation of the gums, and the alveolo-dental periosteum, the tooth is finally pushed out of the socket and is lost after causing symptoms, of which pain is the least to be regarded, especially in a numerous class of patients, who have gums spongy and liable to bleed.

It is observed, besides, that in almost all cases where the teeth grow firm again, after this operation, that a fistula between the neck and the gum is formed, through which pus, produced by the parts contained within the alveolus, is discharged; and even when in young and healthy subjects, they recover their firmness without leaving any traces of their luxation, in the course of three, or at most, five years, no longer receiving the fluids which give them vitality, they lose their color and present an appearance almost as disagreeable as would result from their entire loss.

For these reasons we do not hesitate to declare formally, that luxation, resorted to as a means of preserving a diseased or irregular tooth, is too doubtful in its results, in the present condition of the service, to be classed among the regular operations. We do not even make an exception in favor of the incisor and canine teeth, the loss of which is so much to be deplored, and for a still stronger reason, the small molars, which, however, Maury pretends to have luxated without any other inconvenience *than a little sensibility*. This author in saying * that the force given to the instrument during the performance of this operation, should be very light, in order to *lacerate, in the least possible degree, the vessels and nerves distributed to the tooth*, would seem to show that he was not aware of the object for which this operation is proposed; to rupture the vessels, and in this manner to extinguish entirely the sensibility of the tooth;

* Ouvrage cite, p. 257.

and in advising the operator to *fracture the edge of the alveolus as little as possible*, he himself pronounces condemnation upon an operation of which he proposes to be the defender.

We presume none will regard as contradictory what we have here said, and the advice we gave in our pathological part to endeavor to maintain in their places, and preserve from external violence, such teeth as have been accidentally loosened or luxated: in such cases an absolute necessity exists which forces the dentist to disregard no means of restoring such teeth.

SEC. 5.—*Excision of the Teeth.*

The excision or amputation of a tooth is the complete section of its crown. Recourse is had to this operation in a canine or incisor tooth, when the crown is impaired and it is desirable to preserve the root, for the purpose of preventing the adjoining teeth from approaching each other, which, as we have already shown, would be the case if the roots were removed—to receive the pivot of an artificial tooth, or to furnish a support for an apparatus of any kind whatever. This operation is sometimes effected without the aid of a dentist: that is, by the action of the jaws upon such hard substance getting between them, in cases where the teeth are very much decayed. In such case nothing more remains to be done, but to file down the remaining portion of the crown, so that the gum will cover the bases of the artificial teeth. This operation should never be attempted before the age of eighteen or twenty, because, till then, the dental canal has not become sufficiently narrow to prevent the easy entrance of air and food, the contact of which might have the effect of irritating the nerve and the central pulp.

The instruments necessary for the performance of this operation are a saw, a file, and a pair of strong cutting forceps. The file and the saw have the common inconvenience of producing an unpleasant jarring and a setting of the teeth on edge. The saws, which are used, should be fixed in a curved carrier by their two extremities, in such a manner that they can be used in a perpendicular direction or at right angles. They may be obtained so small as to be scarcely the thickness of a sheet of

paper and not more than a line in width ; they can of course be passed between teeth situated very closely together.

When it can be done, the saw should be insinuated into the space where it is to act, and so fixed in the carrier that when it reaches the neck of the tooth it can be turned so as to cut across ; this can generally be done with ease, as the space is always greater at that part. If the blade cannot be passed between the teeth, it should be taken from the carrier, and after passing one end, with the cutting edge turned from the gum, between the affected teeth, at the neck, it is again mounted in the mouth. But this is rarely necessary, for when it becomes important to sacrifice the crown of a tooth, little hesitation will be felt about removing so much of it as will open a way for the saw.

When the file is used in the excision of the teeth, it hardly serves any other purpose than that of making a horizontal groove, near the neck, to assist the action of the cutting instrument, which plays the principal part in this operation. This instrument, generally, is a pair of strong cutting forceps, either straight or curved, with the jaws concave, so as to embrace the neck of the tooth to be excised ; the handles are sufficiently long, and strong, to exercise a pressure capable of removing the crown, without causing it to crack. Common observation demonstrates that a living tooth is cut off more easily, with less crushing, than a dead one ; the juices, with which it is supplied, renders its tissue more elastic, and, consequently, less brittle.

The facility with which this operation may be performed, when the forceps are well constructed, some years since, induced many dentists, among others an English practitioner,* to substitute it in almost all cases, where extraction was thought necessary, as a means of relieving pain. The fact upon which they founded this practice, is, that in at least eighty-four, out of an hundred, cases, of tooth-ache, the pain is situated in the

* This practitioner, is Mr. Fay, of American origin. The pamphlet, in which he has developed the advantages of this method, compared with the result of extraction, was printed at London, in 1827, under the title of "A Description of the Mode of Using the Forceps, Invented for the Extraction and Excision of Teeth."

crown, and not in the root; and the advantages which they attribute to this operation, over that of extraction, is, that it is less painful, and, that the roots are not only preserved, so as to furnish a base for artificial teeth, but their presence prevents the absorption of the alveolar process, which would take place if they were removed, and the consequent displacement, loss of the teeth, and sinking in of the cheeks.

The excision of the teeth for the cure of tooth-ache, has not, by any means, met with general approbation; because, say its opponents, as the nerve is not entirely destroyed, the impression of the air, the slightest sensations of heat, or cold, the contact of any foreign body, whatever, suffice to produce pain of a very violent character. To this objection, we reply, that such inconvenience is very easily avoided, by making it an invariable rule to follow the excision, by the cauterization of the nerve, particularly, as we have already remarked, in patients who have not passed the thirtieth year. Our personal experience has convinced us, that, although some English practitioners have exaggerated the advantages of this remedy; the French dentists, on the other hand, have neglected it too much, and, that, if its application were better studied, it might be found of much value.

There is, however, another objection to be urged against the excision of teeth, as a general practice, which is, that when the desired object is accomplished, one of the principal aids in extraction is removed, for it cannot be denied, whatever some practitioners may say, that the extraction of a root is, in most cases, more difficult than that of a tooth, whose crown is entire. For this reason it is quite necessary that those who desire to substitute the excision of teeth for their extraction, should carefully examine them to ascertain whether the disease, for which the crown is removed, has not extended into the root or roots. This may always be feared when the pains occasioned in a tooth, by caries, has been accompanied by a discharge, and particularly, alveolar abscess, for, in such case, it is probable that the root, or its coverings, are diseased; when the decay is too trifling to account for the pain which is suffered, it may be suspected that there is exostosis of the root or alveolus, or some affection of that nature.

Finally, there are persons for whom it would be advantageous to substitute excision for extraction; we allude to those persons whose teeth, previously extracted, we have reason to believe, from the examination of teeth, or other indications, have roots, which, by their extraordinary divergence, or convergence, would render their extraction difficult and dangerous.

SEC. 6.—*Of the Extraction of the Teeth.*

Of all the remedies for diseases of the teeth, there is none which have been practiced so long ago as their extraction; for, not only is it spoken of in formal terms, by Hippocrates, who, also, attempts to correct the abuses to which it might lead, but, a passage in Cicero, designates Esculapius, the third of that name, as the person by whom it was first proposed.*

In one of the preceding chapters, whilst describing the causes, and the deficient characters, and treatment of diseases of the teeth, we pointed out most of the pathological circumstances which authorize their extraction, and render it essential; but there are other circumstances, not noticed, which are of importance to the dentist, who desires to practice his art conscientiously. To be contented by saying, with a modern author,† that teeth should be extracted, “in all cases in which the caries has penetrated to the pulp cavity, and it has become sensible to impressions of cold, or heat; and that mastication causes them to be painful,” we are inclined to think, is generalizing rather too much, is throwing doubt upon the utility of the operations which we have described in the previous portions of the work, and is exposing the teeth to a destructive vandalism; on the other hand, it is, we think, disregarding the necessity of extracting teeth perfectly healthy in themselves, but which exert an injurious influence upon the adjacent parts, of which we have presented cases, in treating of absorption of the alveoli.‡ Indeed, the

* *Tertius, (Esculapius,)—qui primus purgationem alvi dentis que evulsionem, ut feriunt, invenit. De Natura deorum, lib. 3.*

† Maury; *ouvrage cite*, p. 260.

‡ Of all the authors who have written on our art, Bunon has best established the grounds of the occasional necessity of the extraction of a sound tooth. This necessity he has demonstrated by a great number of cases.

presence of any one of the indications laid down in the above general rule, is not sufficient to justify the extraction of a tooth, and where they are all present together, it is not always authorized. Thus, to preserve a tooth deeply decayed, it is often only necessary to cauterize or scrape it, in order to arrest the progress of decay, and afterwards to plug it, in order to protect it from impressions of heat and cold, and, finally, to remove, with the file, such asperities as would interfere with mastication. But even if the indications for extraction do exist, should we not defer its performance, in such case, for instance, as the following: when the affected tooth is buried in suppurating tissues—when the patient is a prey to another malady, upon which the shock of the operation might have a bad effect—when patients are so nervous, that the simple preparations alone for the operation, would produce very serious symptoms; this is very often the case with women and children of the higher classes.

The extraction of a tooth, then, which is, unfortunately, regarded with indifference by most persons, is an operation which should be performed, by the dentist, jealous of the public good and his own reputation, only in the last extremity, that is, when there exists an absolute necessity, and in cases where the fear that a tooth may become the cause of deformity, demands its removal, the reasons upon which this necessity is established, are deduced, generally, much less from the physical alteration of the tooth, and the pain to which it is subject, than from the persistence of this pain.

In making up a decision in this matter, how much prudence and attention is necessary, in order to avoid the commission of error! A tooth should never be extracted until the operator is

The most remarkable of these is that of the Marechal de Saxe, whom he could only relieve of a habitually recurring tumefaction of the cheek, by extracting, in opposition to the opinion of the most celebrated practitioners of his time, a perfectly sound tooth; the alveolus of this tooth, however, was destroyed to such an extent, as to form, exteriorly, a pouch into which a blunt sound could be introduced. See his work, entitled "*Experiences et Démonstrations pour servir de suite et de preuves à l'Essai sur les Maladies des Dents*, 1 vol. in 12, 1764.

positively assured that it is either the seat or the cause of the pain; he should not always regard the directions of the patient, for it is very often the case that some tooth, other than the one which is pointed out, is the cause of the trouble. Two adjoining teeth, equally decayed, may both ache at the same time; one only may be really painful, and the disease may be in one in which the decay is hidden, as well as in that in which it is apparent. Sometimes, indeed, it has been observed that the extraction of a perfectly sound tooth has afforded temporary relief from pain, which was caused by a diseased tooth in the vicinity. Garenggeot relates a case of this nature.* It is often the case that the patient does not know the seat of the pain, or it is in the jaw opposite to that which they indicate. Very lately, a young lady called upon us to request the extraction of the first left small molar of the inferior jaw, whilst it was quite evident to us, by the color of the swelling about the same tooth in the upper jaw, that this was the true seat of the pain she was suffering. We had great difficulty in persuading her that this was the case, and we did not succeed in convincing her, till we introduced an instrument into the cavity of the upper tooth; this revived the pain, which had ceased for a moment, and she was satisfied. Finally, it is often the case that the pain is not confined to any particular tooth, or to any number of teeth, but extends to all parts of the mouth supplied by the dental nerves, so that it is altogether impossible to fix upon one tooth more than another. We refer the reader to what we have said with regard to dental neuralgia, in a former part of this work, in which the pain, although felt in the teeth, is caused by some disorder of the dental nerve, and extraction, in such case, would afford no relief.

The operation of extraction should never be performed until the dentist has ascertained, with certainty, the diseased tooth; if a shadow of doubt remains, no effort should be unemployed, which can tend to dissipate it. After the patient has pointed out the tooth which he supposes to be the seat of pain, it should be examined with the eye or small mirror, to ascertain the ex-

* *Nouveau Traité des Instruments de Chir*, tome 2, p. 66.

tent of the decay, and then moved slightly with the thumb and finger; if this should not excite pain, it should be struck with a hard body, such as a plugging instrument; cold water should be taken into the mouth, and brought in contact with it; or another means should be employed, which, though more painful, is still more certain: the cavity should be explored by a small instrument, the use of which, as in the case to which we have above alluded, is sufficient, generally, to furnish a certain indication of the condition of the tooth.

It is certainly a very important step to have ascertained the diseased tooth, but it should still be borne in mind, that, no matter how much prudence and skill may be called into requisition, and whatever may be the instruments used, this operation is alway painful. A skilful dentist should even be able, on the first inspection of the tooth to be extracted, to judge of the degree of difficulty he will encounter, and the intensity of the pain which will be produced. If the tooth is so much decayed that it cannot be expected to bear the pressure of the extracting instrument—if the crown is so small as to indicate that the roots are long and divergent—if the patient is of an excessively nervous temperament—if the tooth is surrounded by inflamed and painful tissues—these unfavorable circumstances should be considered, and the patient informed, with as much address as possible, of their existence, and the probable result, so that, in the event of complete failure, or of incomplete success, he may not blame you for lack of foresight, nor accuse you of want of skill.

As this operation, except in the eyes of those who delude themselves, is one of manual dexterity, it must not be believed that pathological and anatomical knowledge can supply the want of a practiced hand; the contrary, indeed, is daily evinced, by the success, even in the most difficult cases, of empirics or the most ignorant dentists; it is, therefore, of great importance that the dentist should accustom himself to the use of all instruments for the purpose, to become familiar with their various forms, to ascertain with exactness their mode of action, and to become enabled to distinguish, promptly, those cases which require the application of one kind in preference to others.

With children, especially, is this judgment and promptitude necessary, for every unsuccessful attempt frightens them, and prevents them from submitting to a new attempt; it is, besides, important to use all possible address to prevent them from seeing any thing which will excite their alarm. The solicitations of parents very frequently produce an effect the very opposite of that which they anticipate. Fox, with much reason, has said, "It is better to say nothing to the child about your intention to perform the operation, up to the moment when it is effected; in wishing to prepare it, the imagination is excited with dread, and at the decisive moment he loses courage."

From this minute but indispensable detail of the precautions which should precede this operation, we pass on to the examination of the instruments used, attaching much less importance to their formation, than to the true methods of using them, and the precautions by which their use should be guarded.

Of the Instruments generally used for the Extraction of the Teeth.

If we have been obliged to see that dental caries is an affection against which almost the entire materia medica has been directed, we are now constrained to declare that there is no surgical operation, for the performance of which so many instruments have been invented, as that which is at present under consideration. From the forceps, which, according to Erasis-tratus, were deposited in the temple of Apollo, down to those which Hippocrates advised to be used, and from the last down to those we use at the present day, this instrument has undergone the most singular changes in form; and, although the number of new inventions have considerably diminished, especially of late years, they are still sufficiently numerous to form a curious collection. But, whatever may be their formation, they all act as levers, the object of which is to separate the teeth from the jaws, by making use of an effort which overcomes the resistance offered by these organs upon the alveolar processes, or rather the force of adhesion which maintains them united to the entire alveoli. But what is a lever? This it is important

to know, in order to appreciate the manner in which these instruments act, and to turn each to the best account. This piece of knowledge will serve, too, to enable the reader to appreciate the various combinations which furnish the basis of the dental prosthesis.

A lever is what we call a shaft, or inflexible bar, straight or curved, by means of which one power, aided by a fulcrum, endeavors to equilibrate, to sustain or overcome a weight or resistance placed upon a third point of its length. There are four things essentially distinct, to be observed in all species of levers : 1st. The resistance, which is the load we wish to raise, or the body we desire to extract ; 2d. The power, or force we use to overcome the resistance ; 3d. The fulcrum, which is the fixed point upon which the lever moves ; 4th. The arms of the lever, which are the portions of the shaft, equal or unequal, comprised between the fulcrum and the resistance or the power, or between these two. The relative disposition of these four parts constitutes three distinct orders of lever.

The first order is, that in which the fulcrum is situated between the resistance and the power, and from this cause has been named the *inter-mobile* ; of this order, the balance and the scissors are examples. In the second order, the resistance is found between the fulcrum and the power, and is called the *inter-resistant*, as the crowbar. In the third class, the power is between the resistance and the fulcrum, as in the vice ; this has been called *inter-puissant*.

The force of the power and the resistance, as well as the space traversed by the points to which they are applied, is in direct proportion to the length of the arms of the lever. Thus, if the arms are of equal length, and the same degree of force be applied to both extremities, the power and the resistance are equal, that is, they are reciprocally equilibrated. If the forces are unequal, the equilibrium is destroyed ; but the movement which results from this inequality of force is precisely the same for the points of resistance and power. Finally, when the arms of the lever are unequal, the power acts with as much more energy, and traverse, proportionally to the resistance, a space as much greater as the arm of the lever towards its side is larger

than that of the side of the resistance, and *vice versa*. For instance, if the arm of the power is twice as long as that of the resistance, the force being equal, the power will act with double the degree of energy, and, in order to neutralize the forces, or to produce equilibrium, will require the resistance should be double its weight.

We will conclude by saying that, of the three orders of lever, the second or inter-resistant, is most favorable to overcome great resistance; next comes the first, or inter-mobile; as to the third order, it is most unfavorable of all, the power acting between the fulcrum and resistance, which prevents it from being used with advantage when the resistance is greater than the power. We will now apply these physical laws to the description and methods of using the instruments appropriated, at the present day, to the extraction of the teeth.

The number of instruments, as we have said, was formerly immense, but has now diminished to some seven or eight. Some practitioners, indeed, and among them we take pride in classing ourselves, or to whom, for a long time, we have set an example, have the good sense not only to give the preference to those instruments whose mechanism is most simple, but to make use of some three or four exclusively, which they endeavor to apply appropriately, and to handle skilfully. For this reason, the *tirtoir*, a species of hawks-bill forceps, the inferior portion of the beak of which is flat, and rests upon the gum, whilst the superior, mounted upon this by a screw, is directed by the thumb, and, passing behind the tooth, answers the purpose of the hook of the key; the *pelican*, a sort of key, with all the objections, without any of the advantages which are supposed to attach to the latter—the *poussoir* and its *masse de plomb*, etc., are generally, and very properly, discarded. Hardly any others are now retained, but the *key of Garenggeot*, the *simple lever*, (elevator,) the *pied-de-liche*, the *langue-de-carpe*, the forceps, the straight or curved *davier*, (hawks-bill forceps,) and, finally, the pelican, which some practitioners persist in using. We will now give a summary description of them, without entering into details, which would be altogether useless to those who have never seen and handled them, and superfluous to

students who have frequented a dentist's office, which is the only means of becoming a good practitioner.

1. The key of Garengeot is a complicated instrument; it is composed of a moveable hook, articulated transversely upon a smooth, somewhat quadrilateral body, called the bolster, which is placed at the extremity of a shaft of steel; this shaft is terminated, at the other extremity, by a handle, which is fixed transversely, and which is grasped by the hand of the operator. As will be seen, this instrument forms a lever of the first order; the hook seizes the tooth which is the resistance, the bolster rests upon the alveolus, opposite to the point where the hook catches, and, at the other extremity of the shaft, where the handle is fixed, is the power, which is the hand of the operator. This instrument, which is more used than any other, is of very ingenious construction, for there is no tooth or root which may not be removed by means of it. But the question, whether it is as easy for the patient as for the operator, arises here; and candor compels us to answer this question in the negative. Whatever, indeed, may be its conformation, it always compresses, forcibly, between the hook and bolster, the tooth and opposite alveolar process, covered by the gum; and, in consequence of the circular motion which it causes the tooth to describe, in the direction of the movement given to the handle, the extent of which is in proportion to the length of the root, a pressing apart of the walls of the socket cannot be avoided. Now, in the first case, one of two things occurs, either the hook and the bolster are placed entirely above the neck of the tooth and the edge of the alveolus, when the operation fails entirely, or the tooth breaks: or else it is applied lower down, the tooth is more firmly grasped, but, even in the beginning, compressing the alveolus and lacerating the gum. In the second case, the roots, in making a circular motion, almost always fractures the socket, and carries away a portion of the gum, as is seen by every practitioner daily. Many persons imagine that they may divest the key of some of its disadvantages, by raising the instrument more than it is rotated; but that this is an error, the most simple examination serves to demonstrate; indeed, the very first step in the process is to fix the instrument solidly, by

turning the handle, and thus bringing the hook towards the fulcrum. If you attempt to extract the part thus seized by elevating it, you reduce the key to the character of a simple forceps, with, however, these disadvantages, when compared with that instrument: a loss of power, in consequence of the two angles which are formed by the hand in relation to the handle and the hook to the shaft; and with less convenience, because you make use of the instrument in a horizontal direction, while you use the forceps in a straight line.

We know well that it will be replied that when a root is to be extracted, the key does most excellent service, for, however slightly the extremity of the hook is pushed down or up, according as the root is situated in the lower or upper jaw; but then it is evident that the piece of alveolus between the hook and the root will fly away as the root is extracted. This objection cannot be overcome in any way, for if the extremity of the hook is kept above the edge of the alveolus, the pressure of the fulcrum upon the opposite side of the alveolus is liable to produce fracture in that part. The precaution should always be observed to separate the alveolus from the portion of gum which covers it; for, without this is done, the gum is always certain to share the fate of the alveolus, and be torn away with it.

The disadvantages of the key are so very evident, that there is not a practitioner of any reputation, from Jourdain, (1790,) down to Messieurs Delabarre and Maury, who have not felt the necessity of submitting it to some modifications. Some have bent the shaft near the bolster, and this seems to be one of the most important modifications; others have carried the bolster before or behind the hook, a modification which renders the instrument liable to loosen an adjoining tooth; and others, finally, have believed that, by substituting hooks bent at almost a right angle, for those of a semicircular form, a better hold will be taken of the crown, upon which the latter are liable to slip. Two things, however, have caused us great surprise: the first is, that no one, before ourselves, should have thought of disembarassing the extremity of the shaft of the screw, which adds to its length, and of placing the hook directly on a level with the shaft, so that there would be no obstacle in the way of

applying it directly to the wisdom teeth, for the extraction of which they seem particularly appropriate; the second is, that practitioners who have used the key habitually, should have been so long in discovering the advantages of a round bolster, which permits the hook to take any desirable direction. Maury is very evidently deluding himself when he believes that he is the originator of the improvement consisting in the removal of the bolster, so that when the hook is applied, for the extraction of the third molar, that part of the instrument rests against another tooth. This credit belongs to an English practitioner, as is clearly proved by the following sentence from Fox: "Mr. Spence, in placing the hook beyond the bolster or fulcrum, has overcome all these difficulties; because, by resting the bolster against the external side of the second molar, the hook is carried to the inner side of the third molar, which may be removed without the least risk." We regard this modification as an improvement only in relation to the difficulty which is often experienced in bringing the ordinary bolster to bear upon the external face of the wisdom teeth; in all other cases, we regard it as dangerous to make a fulcrum of any other tooth than the one we wish to extract, because the force proper to the bolster and that inherent in the power, no longer counterbalancing each other, the tooth which furnishes a support for the first may be pushed in, whilst the other is forced outward; the only qualifying circumstances in the case is in the relative firmness of the teeth to be extracted, which can never be determined *à priori*, and that which results from the distance which separates them from the power; this, however, in any case, is of little consequence.

The most of these corrections and modifications, we repeat, have not obviated the vices which flow naturally from the mode of action of the key, and have been proposed, we are forced to say, more, perhaps, in a spirit of self-love, than from a conviction that they were real improvements. For ourself, we have, for a long time, almost entirely renounced the use of this instrument, confining it exclusively to cases of teeth which there is reason to believe have strong roots, and which offer a good hold; and, even then, we only use it to luxate them; it may, therefore, be readily imagined how much we were astonished

to find a modern author maintain,* that "the key of Garengéot is, beyond contradiction, superior to all other instruments : " and more particularly when this author pretends to extract teeth not only without effort and without producing pain, but with certainty and with pleasurable sensation, (*tutò et jucundé.*) Such are the expressions of which he makes use!

M. Duval is far from sharing this predilection for the key, for, many years ago, he said, with regard to this matter: "Let no one believe that I am an advocate for the use of the key of Garengéot, as I have not made use of it twice in two hundred operations.† M. Duval, however, may flatter himself with having been the author of one of the most valuable improvements which this instrument has ever undergone, that of making the fulcrum movable, so that, in consequence of its articulation with the shaft, it exercises a uniform pressure upon the gums, during all the steps of the operation of extraction. It is proper to observe here, that those surgeons, (some dentists, however, who, perhaps because they are ignorant of the proper use of better instruments, recommend the key,) who have taken the trouble to acquaint themselves perfectly with the mode of action of the key, do not pretend to deny that it generally *causes fracture of the alveolus*, but are contented with declaring that skill, in the use of the instrument, simply "*consists in causing the slightest possible fracture of the socket.*"*

But for those persons who desire to learn, as we have done, by experience, the disadvantages of the key, we will describe the manner in which it should be used. As for all other operations in the mouth, the first step should be to place the patient in a good light; a hook should then be selected, of such size that its curvature will be proportioned to the volume of the tooth, (this is important, for, if the hook be too large, there is danger of taking away parts of the alveolus where the point touches, and if too small, there is, on the other hand, great danger of breaking the tooth,) it should be fixed in its place so

* Lefoulon : *ouvrage cite*, p. 303,

† *Journal de Méd. Chir. et Pharm. de SEDILLOT*, Janvier, 1814.

‡ MALGAIGNE : *ouvrage cite*, p. 112.

that when the key is held horizontally the handle will be toward the breast, and the bolster looking upward, the hook will fall over upon it from left to right, if it is about to be used for the extraction of a tooth on the right side of the lower jaw, or the left side of the upper jaw, and *vice versa*, if the tooth is situated in the left side of the lower jaw, or the right side of the upper. The bolster should then be well wrapped with a strip of linen, or, which will answer the same purpose, a pledget of cotton, a piece of sponge, or caoutchouc of sufficient thickness should be placed upon the gum, where this part of the instrument is to rest. The operator places himself behind the patient, if the tooth to be extracted is in the upper jaw, directing him to throw the head back; if the tooth is in the lower jaw, he places himself before the patient and fixes the head straight. Then, holding the handle of the instrument firmly in the palm of the right hand, he extends his fore-finger to the hook, which he throws back from the fulcrum and holds motionless; he then applies the hook under the neck of the tooth, almost always on the inner side, and as near as possible to the edge of the alveolus, (but never on the gum at the part corresponding to the middle part of the root, as recommended by M. Begin,)* and fixes it in this position with the fore-finger of the left hand; then rotating the instrument slightly outwards, he grasps the tooth in such a manner that the whole of the crown is lodged in the curvature of the hook, and on the opposite side, the position of the bolster corresponds to the upper extremity of the root, and its lower portion is a little below the point of the hook, when, from the resistance which will now be met with, it is satisfactorily ascertained, that the tooth is firmly taken hold of, the operator gives to the instrument a strong motion of rotation and elevation, and extracts the tooth from within outward by two prompt and consecutive steps, the first to raise it and

* With regard to this matter, M. Begin expresses himself as follows: (*Dictionem et mot cites*, p. 209.) "Hooks terminated by a single point may also be used, this point is placed *upon the gum*, at a level with the *middle part* of the root. When the key is armed in this manner the hook *incises the tissue of the gum*, and takes hold of the root, which it raises and removes."

the second to turn it out of its socket. The tooth in being extracted, comes from its socket in a line of from forty-five to fifty degrees.

Some practitioners, fearing that the turning down of the tooth so low as above recommended will be often accompanied by fracture of the alveolus, and desiring to bring the action of the key to bear as near a resemblance as possible to the movements of the forceps, which facilitate the extraction of teeth, suggests that the tooth to be extracted should not be thrown down lower than an angle of fifty-five or sixty degrees, but that the same thing should be done in an opposite direction, that is to say, toward the inner side of the mouth, of course turning the key so as to make the hook act from the external surface of the tooth—in a word, to luxate it both directions. This idea is certainly, very reasonable, and its application to practice, would have great advantages if the time necessary to reverse the hook would not be a period of almost insupportable suffering to the patient, and if the difference in volume of the teeth or the external surface were not greater than it is within, thus rendering it more difficult to turn the tooth toward the inside of the mouth.

As this last objection, however, is not of serious consequence, all that is desirable is to effect some arrangement by which the reverse movements can be made without displacing the hook; that is, by two simple movements of the wrist. If to this improvement could be joined that of applying directly the hook and bolster to the same tooth, the greater part of the objections to the key would be removed, it would no longer present any disadvantages, except those which attach to all methods of extraction at present known; with this one superiority, however, the immense increase of power.

Generally, the entire extraction of a tooth is effected by means of the key alone; sometimes however, and we recommend this expedient as a palliative for the disadvantages with which we have reproached this instrument, after having effected the luxation of the tooth the operator stops just at the moment when he feels that the alveolus would be fractured, and the gum torn, and finished the operation by the means of straight or curved forceps to which he gives a rotary motion, slight enough to

avoid the threatened danger which induces him to arrest the action of the key.

Finally, we will say a few words for the benefit of those who, in spite of what we have already said on the subject, desire to make habitual use of this instrument; we would advise them to be careful to have the bolster sufficiently large and thick, to form a solid and direct fulcrum, without being liable seriously to wound the mucous membrane and the gum which it covers; to have the shaft so curved that it will be prevented from injuring the other teeth; to have this shaft quite long in order that the eye may follow the operation, and, particularly in order to augment its power, as we have demonstrated in our remarks upon the general theory of levers.

It is, besides, important to know that if the hook is not firmly fixed, or has been carelessly applied, or is displaced by a movement of the patient, it may slip partly off the tooth to be extracted and partly on the one adjoining and draw out both teeth at once. Finally when it is ascertained that the tooth is out of the socket, it should instantly be released from the instrument by a reverse movement of the wrist; this is important as it often occurs that the patient, satisfied to be disembarassed of the tooth, may make a movement which is liable to tear the gum seriously, if a portion happens to be attached to the tooth.

2. The *davier*, after the key of Garengéot, is an instrument more used than any other for the extraction of teeth; it is a species of forceps the beaks of which are bent in the direction of their articulation, so as to resemble the two mandibles of the beak of a parroquet: that is, the superior, which is a continuation of the female branch, longer than the other, is curved from above downward, so as to form a half circle, and the inferior from below upward so as to form a quarter circle. The superior branch is about six or eight lines long, measured from the point where it leaves the joint, to its extremity; the inferior is about a line or a line and a half shorter, the extremity of each is about a line and a half in thickness. The entire length of the instrument is, generally, about six inches; they are sometimes, however, made of smaller size as those intended for the extraction of the deciduous teeth.

This instrument is particularly used for the extraction of the large and small molars of the lower jaw, as also those of the right side in the upper. If well made, the points of their beak will nearly close, in order that the smallest pieces can be taken hold of and they should have a degree of concavity perfectly proportioned to the convexity of the body of the tooth which they are intended to extract; the handles, should be slightly roughened in the manner that most of these instruments are made to prevent the hand from slipping; they should neither be so short and thick as to prevent the operator from handling them with ease. The handles are both curved and straight: the first form is that which was first adopted, but some practitioners prefer them straight for the teeth of the upper jaw; because the fingers are better able to appreciate the degree in which they have been brought down than if they presented a convex line upon which the fingers are liable to slip—this form offers, besides, other advantages.

The davier, when it is used, is taken in the whole hand, with the convexity of the longer portion of the beak looking upward, the thumb is placed against the rivet which unites the two branches, the second phalange of the fore finger upon the opposite side, and the little finger placed between the handles to open the instrument and direct it at will. Thus held, it is introduced into the mouth, and the shorter branch of the beak is applied to the external face of the neck of the tooth; then holding the instrument firmly, the wrist is so elevated as to bring the beak of the longer curve as far down as possible on the internal face of the neck of the tooth, pressing down the gum. When certain that the tooth is firmly grasped, it is pressed down, and drawn from within outward by a moderate and progressive effort at the same time that it is elevated, and some movements back and forth made.

The davier evidently acts as a lever of the first order; the fulcrum, upon which the tooth presses at the moment of extraction, is the short branch of the instrument which is fixed against the external face of the neck of the tooth; it is placed between the resistance, which is that part of the tooth upon which the long branch of the beak acts, and the power, which is the hand of the operator, at the other extremity of the lever.

There is a great analogy between this instrument and the key of Garengot, if not in their confirmation at least in their mode of action: the longer branch of the beak of the former corresponds to the hook of the latter, the other branch almost straight, corresponds to the bolster of the key, the two handles taken together correspond to the shaft upon which the handle of the key is fixed. But there are these differences between the two instruments, which are in favor of the davier: 1st. The shorter branch of the beak, which forms the fulcrum upon which turns the tooth, does not rest upon the alveolus, nor the gum which covers it, but upon the tooth itself; 2d. The power acts in a straight line and not as with the key, obliquely, which prevents the appreciation of its *action*.

When an operator is accustomed to the use of the davier, he may apply it very advantageously for the extraction of the small and the two first great molars, but never, (as Fournier, in his "*Dictionnaire des Sciences Medicales*,"* and Maury, in his treatise,† have advised,) use it for the extraction of the incisors, and canine teeth of which it will be too liable to break the outer plate of the alveolus. We have never been able to explain, to ourselves, why a practitioner so experienced as Laforgue, should have expressed an opinion so erroneous as the following: "The davier should be employed for the extraction of *all* the teeth of which it can take hold, and which the commissure of the lips does not prevent it from reaching; *it alone* is preferable to all others for these cases."‡ Finally, several precautions are necessary to be observed in the use of the davier; the teeth should be firmly seized on the side opposite to which the tooth is extracted, so as to prevent the head of the patient from following the hand of the operator; the operator should be careful not to press too hard upon the instrument, as there is danger of crushing the teeth; he should also be careful to extract the tooth in a line with the curvature of the roots so that they may not be broken.

3. The *pincers*, or forceps, in consequence of its ancient usage in

*Article *Davier*; tome viii., p. 88.

†*Ouvrage*, cité p. 276.

‡*Séméiologie buccale*, ou *Traité des Signes*, etc., p. 86.

the mechanic arts, it is very probable, was the first instrument employed in the extraction of teeth. It is either straight or curved : the straight forceps, which is commonly used at the present time, is about seven or eight inches long ; its jaws slightly rounded, not more than six or seven lines in thickness, are so made that the points appear to touch when they are closed, the interior faces are hollowed out longitudinally, so as to give lodgment to the tooth to be extracted ; the form and size of these forceps are excessively variable. The handles are either arched or straight ; the latter kind particularly when they are roughened and a little enlarged at their extremities, are infinitely less apt to slip during the effort necessary in the performance of the operation for which they are used.

The straight forceps are used for the extraction of the incisors, canine teeth, and small molars of the upper jaw, but only for the incisors of the lower jaw. In operating with the straight forceps, the lips are raised with the thumb and finger of the left hand, directly if the tooth to be extracted is on the right side, but more ordinarily, passing the arm around the neck if it is on the left side. The tooth should be seized high up on the neck, under the gum, which should be pushed up out of the way of the instrument ; it should then be seized with sufficient firmness to prevent it from slipping, and yet care must be observed to avoid crushing the tooth ; the evulsion of the tooth should then be effected by loosening its attachments by varied movements of suppuration and demi-rotation, as directed by Laforgue, the operator exercising traction toward himself with sufficient force but without violence. We have said here that a movement of suppuration should be given to the instruments in extracting the tooth, because the hand, armed with the forceps, presented to the tooth, should be pronated ; the contrary is the case with the davier when it is used for the extraction of the superior incisors.

When the attentive examination of a tooth to be extracted gives reason to believe that it is firmly implanted in the jaws and is excavated by caries, it is not advisable to attempt too soon to shake it with the forceps, because it would be liable to break under the effort. After each attempt, slight at first, the instrument should be pushed further and further up on the root.

The curved forceps differ from the straight forceps in being curved, and from the davier in being curved in a direction contrary to their articulation; the jaws which are both of the same length and move simultaneously are like the straight forceps, hollowed out more or less deeply, according to the size of the tooth to be extracted. The curved forceps are infinitely less powerful than the davier, which instrument acts as much in producing the circular motion of the key as in extracting the tooth; they are mostly used for the purpose of removing teeth already luxated or which have been loosened by accident, and also to reach those teeth situated far back in the mouth, or teeth half extracted which offer little resistance, or fragments of bone, the remains of broken teeth or fractured alveoli. Reduced in their proportions, these forceps answer most frequently for the extraction of the deciduous teeth; they are made of various forms by which they are perfectly adapted to this use.

There is still another kind of forceps, bent twice between the joints and the extremity of the jaws. This is an useful improvement for the purpose of reaching far back into the mouth, or to hold the commissure of the lips apart, as the jaws of the instrument are placed in a plane anterior or posterior to the handles.

4. The *lever* is the most simple of all the instruments used for the extraction of the teeth; it is as its name indicates, an inflexible shaft, the purpose of which is to raise up the affected tooth; it is half tempered, partly rounded, but a little flattened and slightly curved at the extremity. It is used principally for two purposes; for extracting stumps of teeth, and for removing the molar teeth by turning them out of their sockets, they are applied for this purpose, particularly to the wisdom teeth, the roots of which are sometimes united so as to form a kind of pivot, and only partially developed. This instrument is about five inches long; the handle is fixed parallel to the shaft.

When used for the purpose of extracting roots, this instrument is forced down deeply, between the wall of the alveolus and the root to be extracted; then, with one of the flattened surfaces, which terminate the extremity, the root is removed by a motion of the wrist from pronation to supination. It does

not, therefore, act, as most authors have stated, as a lever of the first order, but of the third. The resistance is the part of the root upon which the point of the instrument rests, the fulcrum is the extremity of the handle which is held in the palm of the hand, and the power is applied at the part of the instrument seized between the fingers and especially between the thumb and fore finger. It is important to correct this error into which most authors have fallen ; for if it be made to act as a lever of the first order, it must necessarily make the internal wall of the alveolus its fulcrum, which would make it liable to be broken and it would make it necessary to turn the tooth or root toward the inside of the mouth, which is impossible.

When the simple lever is used for the purpose of extracting wisdom teeth, one of its extremities is placed between that and the first molar, so as to make a fulcrum of the latter, and by a movement almost horizontal, causing the tooth to describe a circular motion backward, it is made to leave its socket. It is rarely in such cases that the teeth are entirely removed by the action of the lever ; they should be extracted, if they remain slightly attached, by means of the curved forceps. The *langue de carpe*, is infinitely preferable for the extraction of the wisdom teeth.

5. The *pied-de-biche* (hind's foot) is an instrument possessing advantages which have not been generally acknowledged by some persons, indeed, it has been completely proscribed ;* it is a slight modification of the simple lever which we have just described ; like that instrument, it is a simple metallic shaft, fixed in a handle parallel to its length, but it is curved about three or four lines from its extremity, and bifurcated at the point ; from the heel of the curve is fixed a species of projection which is also bifurcated.

The *pied-de-biche* is used for the extraction of roots ; for this purpose, the cutting part, or rather the extremity of the instrument, is forced between the gum and the neck of the broken tooth or root by pressing down the gum, the root is then raised by pushing from without inward, placing the point of the instru-

* M. Malgaigne is of this number ; see his work already referred to, p. 109.

ment between it and the alveolus, and making a fulcrum close by, by means of the projection which we stated makes a part of the shaft. It cannot be denied that this instrument acts as a lever of the first order, as its fulcrum is upon the edge of the alveolus when the circular motion is given to the instrument; the pressure which would otherwise be made is moderated by sustaining the instrument at this place, or, to speak in physical language, by the attempt to transform it into a lever of the third order, so that the power will no longer be in the palm of the hand, but in the fingers, as we have shown, when treating of the extraction of roots by means of the simple lever.

Before making use of this instrument, it is very important to ascertain, as nearly as possible, the degree of force which it is necessary to employ. For if this force is insufficient, the root will not be removed, whilst if it is much greater than is actually necessary, the alveolus is liable to be fractured, and the parts to be lacerated more or less badly, for, notwithstanding the caution which may be observed to protect the instrument, either with the thumb or with several fingers of the opposite hand, the impulse which it is necessary to give may easily cause it to slip.

Besides the simple *pied-de-biche*, we have sometimes successfully used an instrument which acts precisely in the same manner, but which has over this one, the slight advantage of taking hold of the tooth at the same moment that it is raised out of the socket. This instrument is like that which we have just been describing, a curved lever, but composed of two parts precisely alike and attached to each other, but being separable so as to receive a portion of the neck of the tooth, and capable of being then closed by means of a slide fixed on the shaft which is formed by their union. This instrument presents, at one view, the appearance of the letter T, of which the vertical shaft is solidly fixed in a handle, and the horizontal is curved a little in a direction opposite to its two extremities.

6. The *langue-de-carpe*, (carp's tongue,) is also a curved lever, but its terminated point has the form of a bayonet. The part which near the point, escapes from the shaft is flat, triangular and a little pointed; some authors, therefore, and among others Laforge, call it a pyramidal lever, it is also called the lever of Lecluse, or the *trivelin*.

This instrument, the advantages of which seem little known to modern practitioners generally, is used principally for the extraction of the third molars of either the upper or lower jaw, when the adjoining teeth are close to them or separated but a little distance. The *langue-de-carpe* (carp's tongue) is a *perfect* instrument for the extraction either of the wisdom teeth, by being placed between it and the second large molars, and also for this latter by placing it between it and the first, and so on to the first small molar, when the second is lost, because the canine teeth supported by the incisors are sufficiently firm to answer the purpose perfectly. Beyond this, however, it is unadvisable to go, as the incisors are not sufficiently strong to bear the force necessary to remove the canine teeth. The projection made by the triangular portion also enables the operator to search deeply for the roots of the molar teeth, and the firm fulcrum presented to the fingers by the curve which unites this part to the shaft, gives great force to the power, at the same time that the fingers prevent injuries of the mouth if the instrument should, unexpectedly, slip. The *langue-de-carpe* differs from the simple lever and *pied-de-biche*, (hind's foot,) in having its handle fixed generally transversely to the shaft, like the key of Garenggeot; we generally say for sometimes we have seen the handle fixed horizontally like that of the key, but we have been unable to see any advantages result from this arrangement.

The flatness of the extremity of the triangular part of this instrument makes its introduction between the teeth quite easy. The operator should attempt to press the instrument so far in between the teeth that the thick part may act, as there is then less danger of loosening the sound tooth which acts as a fulcrum; but this is an accident which will never befall a practitioner experienced in the use of this instrument, for he will always be careful to support the sound tooth with his thumb or fore finger, so that he may readily ascertain during the operation, if it is giving way under the force applied; when this does occur, he immediately desists in the use of this instrument and substitutes another for it. If it is desirable to extract a wisdom tooth, and the second molar next to it is deprived of its support by the loss of the first molar, this can be remedied by pressing firmly in the

space a piece of ivory covered with linen ; in this manner any danger of loosening the isolated tooth may be avoided.

We will take occasion to remark, here, that the fulcrum made of the adjoining tooth by the instrument of which we have been speaking, is not so liable to effect its removal as at first sight might be believed ; for in the movements given to the instrument, for the purpose of extracting the affected tooth, acting upon it from the root toward the crown, necessarily acts upon the adjoining tooth from the crown toward the root, which will of course be more liable to press it down into the socket than to force it out.

7. The *lever à crochet et à plaque*, (the lever with hook and plate.) Besides the three species of lever which we have described, there is an instrument which is used for the extraction of certain roots and also some of the teeth ; this is called by the name which heads this paragraph. It is a steel shaft fixed in an oval shaped handle, and terminated at the other extremity, by a hook which bears a great analogy to that of the key. This shaft, grooved longitudinally, is received into the groove of a plate articulated with it and covered with a piece of cork or skin ; this plate is about four inches square, and is pierced with a hole which receives a screw fixing it upon the groove in the shaft.

In using this instrument the extremity of the hook is introduced, as deeply as possible, below the level of the inner side of the root to be extracted, and a fulcrum is made of an adjacent tooth, or upon a small piece of wood applied upon it. A semi-circular motion is then given to the instrument from behind forward, or from before backward to remove the tooth which is grasped. This species of lever as will be at once seen, holds a place between the pelican and the key, but it is less certain than either of these instruments, because the fulcrum is not so firmly fixed. The modification of Maury, of making the hook movable, like the plate, is, in our eyes, far from being an improvement, as it necessarily diminishes its solidity, we never make use of it.

8. The *pelican*, as we have said, is generally thrown aside at the present day ; but, as many practitioners still continue to use it, we believe that we should say something of it, more, of

course, to show its disadvantages than to contribute any thing toward bringing it again into use.

This instrument, as it was used by the older dentists, as Fauchard, for instance, and as it is still used in the north of Europe, is composed of a handle, made formerly simply of wood, but, at the present day, of ivory flattened upon both sides, terminated by a rounded extremity, large and serrated, but generally covered with skin or linen ; this serves as a fulcrum, whilst the other end of an oval form, is received into the hand. In the middle is screwed an elongated hook, the extremity of which is curved like the beak of the bird whose name the instrument bears ; this hook falls in front of the fulcrum formed by the extremity of the handle which we have just described. The pelican is always provided with hooks of various lengths, so that they may fall so far before the fulcrum as to be proportioned to the thickness of the tooth to be extracted ; the free extremity of the hooks, like those used for the key, is small and furnished with too small sharp projections with a depression between them, so as to prevent them from slipping.

The pelican, which has been substituted for the one we have just described, differs in two respects ; first the fulcrum is a plate of metal slightly concave, oval, about an inch long and an inch wide, covered with skin and articulated with the handle by means of a screw ; by this arrangement and the addition of a screw for the purpose, the necessity of changing the hook is entirely obviated, as this part of the instrument may be advanced and brought back at pleasure. The credit of this improvement is due, for the most part, to an English dentist named Bucking and to Dubois Foucou.

In using the pelican, the hook is applied, like that of the key, to the inner side of the neck of the tooth to be extracted ; the extremity of the handle, which serves as the fulcrum, is applied about eight or ten lines in front of the hook, upon the teeth only, if the old pelican is used, but upon the teeth and gums if the improved instrument is employed ; then, by a movement which carries the instrument toward the median line, and by which the hook is drawn outward, the tooth is turned out upon the external side of the socket. If the extraction is not complete, it is finished with the forceps.

From this description the truth of the assertion which we have made, that the pelican has all the inconveniences, without any of the advantages, of the key, becomes apparent. It acts, indeed, like the key in turning the tooth out of the socket, and is, therefore, liable to produce all the injury which can result from this movement; but not having its fulcrum upon the tooth to be extracted, as is the case with the key, it sometimes causes the loosening, and so often the loss of those upon which it rests, that there is not a practitioner, familiar with its use, who has not to regret some serious accident which has happened under his hands, of which we might cite many instances. M. Begin had also observed this result, for, after describing the instrument with such minuteness as would authorise its use, he declares, nevertheless, that nothing is more easy than the luxation of several teeth when it is used.*

9. Finally, the disadvantages of the pelican in exercising a repulsive lateral force upon the teeth adjoining the one to be extracted, and of the key by causing the tooth, in being extracted, to describe a circular motion, struck us, so forcibly, in the outset of our practice, that about forty years ago, we constructed an instrument which is free from either of these objections. This instrument is so constructed that the extraction of the tooth is effected in a straight line, and, at the same time that it is raised, it exercises a vertical pressure upon the grinding surfaces of the two adjacent teeth. It is, consequently, composed of three pieces; two are articulated to the middle part, the superior of which is terminated at one extremity by a hook, similar to that of the pelican, and at the other by a handle similar to the forceps, and, at the inferior portion of the second part, which corresponds to the hook of the first, there are two small wings between which this hook passes; the third piece is another hook, which, in seizing the tooth, performs the office of the shorter jaw of the davier, approaching the superior hook in proportion as the handles of the instrument are pressed together.

But as these wings, if they were permanently fixed so as to act upon the adjacent teeth, would prevent that lateral motion

* *Dictionnaire et mots cites*, p. 211.

which should precede extraction, in all cases, we have made them movable, so that hidden as they are in the instrument, they can be brought at will to bear upon those teeth which are destined to furnish them with a fulcrum; in such case, they exercise what might be called counter-extension, as when it has performed the primitive functions of a simple davier. Finally, as the tooth to be extracted is often isolated, we have for such cases, constructed, in addition to the wings between which the jaws act, other wings, fixed laterally, which find a fulcrum upon teeth situated more or less distantly from the one to be extracted.

This instrument then, strictly speaking, is only a species of davier, from which it differs but little in size; it has, however, this advantage over it, that after the tooth is once loosened it removes it in a straight line, by a simple pressure of the hand; this pressure being limited by the approach of the two handles, can never exceed the desired point, and there is no risk, as in the case of the davier, of striking it against the teeth of the opposite jaw, if the tooth should give way suddenly.

Methods applicable to the Extraction of the Different Classes of Teeth.

The nine instruments which we have just described, are almost the only ones which are used by dentists at the present day for the extraction of teeth; and experience will demonstrate to many, as it has done to us, that with a davier, a pair of forceps, a curved lever, and, perhaps, our own instrument, which combines the advantages of all these without their objections, they may operate honorably in every case which presents itself. If we now apply the precepts, omitted in the course of this description, and indicate, in the order of the teeth, the instruments and the method of proceeding, for the extraction of each class, we will arrive at the following general rules:

1. *Incisor and Canine Teeth.*—The forceps should, generally, be used for the extraction of the incisor and canine teeth of both jaws; but, for this purpose, neither the key, the davier, nor any instrument acting upon a similar principle—that is, causing a

circular motion—should be used, because the roots of these teeth are long, and their alveoli thin, and as large breaches may be caused by any accident occurring here, renders the patient very much dissatisfied, every precaution should be taken to avoid them.

In extracting the incisor or canine teeth of the upper jaw, the operator should generally stand in front and on the right side of the patient, so that he may incline the head in the position most favorable for the operation; but frequently, also, for the teeth on the left side, the operator places himself behind the patient, as we have said above. In extracting the teeth of the lower jaw, it is always best to stand behind the patient; in this position all the anterior teeth, except the canine, are accessible to the forceps. They should also be grasped as low as possible under the gum, to prevent the instrument from slipping from the slope of the posterior side of the neck of the tooth; the instrument should also be pressed as strongly as possible without breaking the tooth, and by movements of the wrist, made firmly but without violence, the periosteum should be separated from the walls of the alveolus. After the tooth is loosened in this way, it is extracted almost perpendicularly. Sometimes the tooth is not loosened in this way, until after many efforts have been made; for it has with truth been remarked by Fox, that all the strength of a man might be used in a perpendicular direction, without extracting it; but after a tooth has been loosened by an oblique movement to the right and left, it may be drawn without difficulty. The teeth of children are always easy to extract in this way, when it has not been thought possible or convenient to take them out with the fingers.

2. *Small Molars.*—The teeth of this class are, generally, extracted with the forceps or davier, especially when they offer a good hold for the instrument, and are not so much decayed as to render them liable to break under the necessary pressure. But each of these instruments has its special application: the forceps are used exclusively for the teeth of the upper, and the davier, is more applicable than any other instrument, for those of the lower jaw. In using the davier the operator places himself in front of the patient and a little to the left, if the tooth to be

extracted is on this side, and behind and a little to the right, if the tooth is on the right side ; the manner of taking hold of the tooth, and the movements given to the wrist, are precisely the same in both cases. Practitioners who are well skilled with the davier, may use it for the extraction of the small molars of the upper jaw : the position of the operator will be the same as it is for the lower teeth, in front and on the left, for those of the left side, and behind and on the right for those of the right side ; but, in either of these cases, the hand is held in the position of suppurator, and the tooth is extracted from within outward, and from above downward. We often operate in this manner, but for the right side only.

3. *First large Molar*.—The first two large molars are readily extracted with the simple lever, or the langue-de-carpe, by placing these instruments deeply in the socket as directed when describing them, and removing the tooth from below upward. The operator should stand on the same side upon which he operates and not, as advised by Gariot, on the opposite side, as he would then be obliged to introduce his instrument between the teeth, from the inner side, which would be very inconvenient, and would render the inner sides of the cheeks liable to be wounded. But for the extraction of the first molar, which is so near the front of the mouth as to be quite accessible, the davier may be used, in most cases, in the same way that it is employed for the extraction of the small molars. Those who are not accustomed to the use of the forceps, may, perhaps, resort to the key ; in using it they should place themselves in front, and on the same side from which the tooth is to be extracted, applying the bolster on the external side of the tooth, and turning it from within, outward ; and this for several reasons, because their roots, incline a little in this direction, because the internal surface, being straighter, furnishes a firmer hold for the hook, and, being thicker toward the outer surface, if they were turned violently inward they would push apart the adjacent teeth.

The roots of the first molars, as we have seen, in studying them anatomically, present very considerable variations. Sometimes these roots diverge to such a degree at their extremities that it is physically impossible for them to be brought through

the opening of the alveoli, so that, in their extraction it is almost impossible to avoid either breaking the roots or fracturing the socket ; sometimes one of the roots is very long and curved, either backward or toward the side, penetrating deeply into the jaw ; again they are so twisted that they grasp a portion of the maxillary bone which inevitably comes away with them. All these circumstances and many others, form obstacles which it is difficult to surmount ; unfortunately it is impossible to find any indication, in the crowns of the teeth, of the multiplicity of their roots, their irregular form or their divergence or convergence.

4. *Wisdom Teeth.*—The extraction of the wisdom teeth is, perhaps, surrounded by more difficulties than that of any others, not because they are more firmly implanted in the jaws, as we know that their roots are often so united as to form but a single one ;* but, first, because being situated further back in the mouth, they are not so accessible to our instruments, because they are, generally, not so well developed as the rest, and then there are besides, inconveniences of position peculiar to each one. Those in the superior jaw terminating the range of teeth are unsupported posteriorly, and their crowns are so rounded that the various hooks, when applied to them, slip off easily ; those of the inferior jaw are placed precisely at the place where the body of this bone commences rising at the external side to form the coronoid process, which, sometimes, at the time it is cut is almost as high as the tooth.

The difficulty attendant upon the extraction of these teeth is very often augmented, from the fact that persons affected by the violent symptoms which so often accompany their eruption, often deceive themselves with regard to the true cause of the pain they suffer, and defer, sometimes, having recourse to us until the accidental complications have rendered the obstacles still more difficult to vanquish. The following case ta-

* Laforgue, is in error, to contend as he has done in the last work by him, to which we have referred, p. 101, that this disposition of the roots of the wisdom teeth is met with but in a very small number of subjects. All anatomists truly assert that it is *very common*. The extraction of these teeth is difficult enough at least, and it is quite unnecessary to add imaginary difficulties.

ken, without selection, from a great number of others which we have collected, in relation to the subject, leaves no doubt about this matter.*

In 1822, our friend Dr. Olmade, was attacked with odontalgia, with which he was tortured for three months; the violence of the symptoms was such that his mouth was closed, spasmodically, and he was compelled to subsist entirely upon liquid aliment. One of us having had occasion to see him, at the time his sufferings commenced, observed that one of the wisdom teeth of the lower jaw was on the point of coming through; he attributed the disorder to this cause alone and advised the patient to have it extracted. Dr. Olmade, deferred submitting to this operation; but his gums soon became inflamed, an abscess formed which caused a fistulous opening through the cheek under the whiskers. At the same time a portion of the maxillary bone become necrosed and some fragments escaped with the pus. At this time, becoming convinced that he could obtain no relief from medicine, he determined to follow our advice; but the operation could no longer be performed but with great difficulty. We succeeded, however, by means of two triangular blocks of wood, in opening the mouth gradually, to about a half inch, when we introduced the forceps which we described in another place by means of which we increased the opening and kept the jaws stationary, at that point. Now introducing the finger in the mouth, we discovered that the wisdom tooth was not completely out; but the opening of the mouth was not sufficient to enable us to proceed to its extraction, and we, therefore, found it necessary, first, to remove the second large molar, the crown of which was almost entirely destroyed. The roots of this tooth were ankylosed to the alveolar walls in their whole extent, although they were very short. It was to this anatomical arrangement to which was to be attributed all the sufferings of the patient. The wisdom tooth, in fact, not having room enough between the angle of the jaw and the second large molar and not being enabled to displace the latter, it had taken an almost horizontal di-

*This case is extracted from those which one of us has published in his "*Thèse Inaugurale sur les Dents de Sagesse.*"

rection from behind forward, so that the posterior face of the crown presented upward. A short time after we effected its extraction, the abscess and fistula closed, but the cure was not completed till after the lapse of two months.

This case, together with those which we have extracted from the clinical lectures of M. Velpeau, one of which we have presented, and the other will be given in the following section, will enable the student to form a just estimate of the difficulties which the wisdom teeth encounter in their eruption, of the gravity of the operation under some circumstances, of their extraction, and the care necessary to be observed in the performance of this operation.

Extraction of Roots.

All the difficulties encountered in the extraction of teeth, and that they are but too numerous we have just shown, will be met with, also, in the extraction of roots of teeth, only that they will there be found still more serious. The blind attachment of the greater proportion of dentists to the key of Garenggeot, is such that they do not fear to apply this instrument as frequently for the extraction of roots as for the teeth themselves. It will be clear, however, to those who give themselves the trouble to reflect a little, as we have demonstrated in speaking of the key itself, that the hook, acting only in proportion as it bears upon the body to be extracted, would be useless as applied to a body which makes very little and often no projection, unless it could be made to penetrate the cavity in which the body is concealed, which is difficult to do with this instrument; or which one can only reach by piercing the alveolus, which is very inconvenient.

The absence of a projecting point is not the only cause which renders the extraction of roots difficult. This difficulty often arises from their being softened about the neck. This softening sometimes extends so far as to affect them in half or two-thirds of their length; that which is sound is situated deeply in the alveolus, or is intimately fixed by means of the alveolar periosteum; or else, the caries having commenced in the dental canal,

has destroyed all the interior of the root, till it has left nothing exteriorly but a very thin lamina of bone, altogether insufficient to bear the pressure of the instruments necessary to their removal. It is often the case, that the part of the root projecting above the edge of the alveolus is covered with vegetations of the mucous membrane of the gums, in consequence of the inflammation which has followed the laceration of this membrane at the time when the tooth was fractured. Finally, fistulous openings are, generally, caused by the presence of roots, and these necessarily complicate their extraction.

The detailed account which we have given of the mechanism and mode of action of the different instruments used for the extraction of the teeth, will indicate that the ones best adapted for the removal of roots, are those which act on the principle of the simple lever. The point of one of these instruments is forced down between the circumference of the socket and the root ; a slight effort of elevation from the side where there is the least resistance, is often sufficient to remove it ; if it is very firm, the same process is followed on both sides, and this generally succeeds. But it often happens that the root, although loosened, still continues to hold so firmly as not to come entirely away, either because the periosteum or the dental cord are thickened and retain it, or because a vicious conformation prevents it from following the line of the axis of the alveolus. If the difficulty results from the first of these causes, the resistance is overcome by thrusting the instrument deeply enough to act upon the root as nearly as possible to its extremity, the operator drawing it by a retractive force towards himself. But if it arises from the second cause, which, unfortunately, it is not easy to foresee, this method of procedure is not sufficient to insure success ; in such case, if the roots of a large molar are the subjects of the operation, they should, if possible, be separated, and drawn out one after another. This is done in the following manner : the neck of the tooth is perforated with a drill, the hole squared, and a strong cutting screw, with a firm handle, introduced so as to break the roots apart. They are then extracted separately. Finally, if the means here pointed out should not succeed, and it is important that the root should be extract-

ed, the instrument should be pressed down between the root and the external wall of the alveolus, which latter should be broken away, and the roots extracted with curved forceps, more or less sharp, according to the depth to which it should penetrate. This painful necessity exists particularly when the presence of the root we desire to extract is the evident cause of some serious disorder, such as a fistula opening through the cheek, a caries of the maxillary bone, etc. etc. This we have experienced in many cases, of which the following is the most remarkable :

The son of a rich merchant of Bordeaux, had been obliged, in consequence of the intense pain he suffered, to resort to the extraction of the first right lower molar tooth, which was deeply excavated by decay. The dentist who was entrusted with the operation, broke the tooth off close to the gum, and consequently left all the root in the alveolus. Two years passed away, during which the patient experienced no inconvenience from the root ; but at this time, (he was then twenty-two years of age,) he felt a constant sensation of tension, not only immediately about the root, but in the adjacent parts, particularly towards the back part of the mouth. It was not long before this feeling of tension took the character of pain, and this pain in a very short time became very troublesome. The dentist who had broken the tooth was again consulted. Not doubting that the presence of the root was the cause of the pain, he attempted its extraction, but all his efforts were fruitless. He then advised the extraction of the adjoining tooth, which, closing up the orifice of its alveolus, prevented the extraction of the root. The father of the young man, not believing that it was necessary to extract a sound tooth, in order to effect the extraction of a root, and fearing for this one the fate of the former, refused to allow the operation to be performed, and advised his son to wait till their arrival at Paris, to which city they were called by business, so that they might consult in the case some of our celebrated surgeons.

On their arrival in Paris, they consulted Dupuytren. This illustrious practitioner had scarcely examined the mouth of the young man, when he perceived, from the deviation of the tooth which covered the root, that the wisdom tooth, obstructed in its

eruption, had pushed all in front of it, and that, under its pressure, the second large molar had been forced upon the root in front of it, to such an extent that this latter had been buried in the alveolar tissue, thus causing the incessant pain experienced by the patient. He then advised that the displaced tooth should be extracted, in accordance with the advice of the Bordeaux dentist, and recommended the patient to M. Delabarre, Miel or myself, to have the operation performed. The preference was given to us. We immediately confirmed the diagnosis of the celebrated professor of Hotel Dieu; but we did not entirely agree with him in the belief that the root could be removed with ease, after the extraction of the tooth whose loss had been determined upon. This tooth was first loosened with the *langue-de-carpe*, and extracted with the *davier*; we then endeavored, but vainly, with many species of lever, to extract the root. It had been forced into the thickness of the alveolus. We were then compelled to detach the gum as low down as possible, and remove, with a small gouge, the external plate of the alveolus. After the root was exposed in this way, its removal with the forceps was easy. The operation was immediately followed by a hæmorrhage, which was arrested by a compress. Emollient fomentations, assisted by repeated foot-baths, with mustard in the water, and some derivative purgatives, arrested the consequences of inflammation, and sufficed to bring about a cure as complete as it was prompt.

When a number of adjoining roots are to be extracted, as it is impossible to use the instruments for that purpose to so great advantage as when they are next to sound teeth, it is well to loosen them, by placing between them the *langue-de-carpe*, to which is given a half rotatory motion. When roots are so much hollowed out by caries as to transform them into mere shells, as is sometimes the case with those of the canine and incisor teeth, it would be presumptuous to hope to extract them whole, and imprudent to promise the patient that you can do so; a very small lever should either be inserted between them and the alveolus, or even into their interior, with which they should be broken into fragments, which are easily removed with a pair of common pliers. The roots of the wisdom teeth,

especially, should be extracted with the langue-de-carpe, which, by its curved form, can readily be made to penetrate more deeply than any other instrument.

We will say, finally, that a dentist of long experience will readily ascertain the amount of resistance which will be met with in each case. Their presumed length, the thickness of the alveolus, the condition verified by touching them, not only of the corresponding tooth, but also of the roots, the swelling of the maxillary bone, the age, the general constitution of the subject, are so many signs by which the difficulties likely to be experienced in their extraction may be judged of. When it is presumed that the resistance will be very great, the root, in most cases, should first be loosened with the langue-de-carpe, and when it is so moved that it offers a hold for the instrument, curved forceps or the davier should be used. In a word, the operator should be governed by the indications of good sense, for no general rules can be made to apply to all cases. We know but a single precept, which should be well understood, and always present before the mind, that is, never to undertake the extraction of a root with the pied-de-biche, without being physically certain of success; for in case of failure, and repeated attempts, with all the address possible, the loosening the other teeth is unavoidable, and also the production of serious disorders, and the rendering impatient and fearful those who with the greatest readiness submit at first to the operation.

Extraction of Teeth situated out of the range of the Dental Arches, and of Concealed Teeth.

In all we have hitherto said of the extraction of teeth, we have had in view cases only of common occurrence; that is to say, such cases only which related to teeth occupying their natural positions along the dental arches; but there are other cases which require certain precautions, or rather, to which certain particular rules are applicable. These are such, for instance, where the teeth, situated *out of the dental arches*, are to be extracted; and also those which may be *concealed in the thickness of the tissues*, inaccessible to the sight, occasioning disorder

which can only be relieved by their extraction. We will examine the methods of procedure in both these cases.

1. *Teeth situated out of the range of the Dental Arches.*—Whatever may be the situation of such teeth, their extraction requires the greatest care, as we have heretofore had occasion to say; for, we repeat, if they are placed immediately behind or in front of the other teeth, these latter may, in some degree, be loosened by the effort of extraction; and if they are situated at a distance from the dental range, there is danger of the instrument slipping, in consequence of the difficulty of taking hold of them, or, in extracting them, to injure seriously the surrounding parts, an example of which we have cited from our own practice. For this reason, it is important that, in extracting such teeth as are situated near the alveolar border, they should be removed with instruments acting in a straight line, without causing a circular movement, which might have the effect of compromising the firmness of those regularly situated before or behind them. When they offer a sufficient hold, the forceps are particularly adapted to their extraction; the straight forceps, when they are situated in front, and the curved when they are situated behind the range of the other teeth, particularly in the lower jaw. The precaution should always be observed to sustain the adjacent teeth, by placing the fingers upon their crowns, so as to become aware of their slightest movement.

But when these teeth are simple tubercles, as is generally the case with supernumerary teeth, it will be difficult to take hold of them with the forceps; it will be necessary, then, to introduce a lever between them and the regular teeth, when they are near them, or into the socket, if they are too far from the regular teeth to allow a fulcrum to be made of them. In such cases as the last, it is often better, we repeat, to excise than to extract them. Examples, however, will do more towards indicating the proper course to be pursued under such circumstances, than reasoning. We will report only the two following cases; the first of a canine tooth, situated entirely in front of the alveolar border; and the second, of three supernumerary teeth, situated within the dental range.

Case 1.—Early in March, 1840, upon the recommendation of

a young English lady, for whom we had brought into its proper position an irregular lateral incisor, Mademoiselle M——, aged seventeen years, was brought to us by her mother, to know if we could render the same service in the case of a superior canine tooth, which, ever since its appearance, being more tardy than usual, had occupied a place exactly in front of its regular place. This tooth, directing itself more and more obliquely forward, had caused an induration of the portion of the lip touched by its point, and held it so much raised as to cause it to be disfigured. The slightest examination of the tooth convinced us that all attempts to bring it into a regular position would be vain. But as the mother seemed very strongly to entertain a contrary hope, we begged to be permitted to take a cast of the teeth of the young lady, and it was very easy from the cast to prove to her the complete impossibility of bringing the irregular tooth into its proper place; first, because the lateral incisor and first molar, between which it would have to be brought, were directly in contact; secondly, because the portion of alveolus situated in front of it was too thick to yield to any reasonable amount of pressure which could be brought to bear upon it; and, finally, because this pressure, even if it could be sufficient, would only bring the point of the crown in the space toward which it should be conducted, as it was implanted much above the edge of the alveolus. This demonstration was too clear to allow Madame M. for a moment longer to oppose herself to our advice, and it was immediately decided upon to extract the tooth. But in effecting this extraction, two things were to be feared; either that the forceps could not be made to pass so far up on the neck of the tooth as to prevent them from slipping, or that the action of the lever, which, in such case, would have to be resorted to, would loosen the regular teeth so close behind it. We therefore determined to extract it with the forceps, but not to attempt to make an effort of traction, until we had displaced it to such an extent as to allow us to push the jaws of the instrument far up on its neck. When it was once well seized, its extraction was easy. But, fearing that the absence of the support to which the adjacent regular teeth had been accustomed, would be prejudicial to their firmness, we fixed a metallic bar

in front of them, thus preventing their tendency to be thrown forward. At the end of a month, the alveolus of the extracted tooth had completely closed, we removed the fixture, and no trace of the operation or the previous deformity remained.

Case 2.—Three months ago, a youth, fourteen years of age, with three supernumerary teeth, on the inner side of the dental arch, was brought to us. They were situated in such a manner that the smallest one corresponded directly to the median line, and the two others, each to the space which separates the middle from the lateral incisor, but a little farther toward the inner side of the mouth than the former, with which they formed a triangle. These teeth did not make their appearance till about the eighth year. Their presence had caused an extraordinary thickening of the anterior portion of the alveolar processes; the dilatation caused by this had separated the central incisors to the distance of about four lines. Quite a remarkable feature in the case is, that the supernumerary teeth seemed to have acquired their size at the expense of the canine teeth, which were so small as hardly to be apparent. We commenced by taking a cast of this curious mouth; a step which we would advise every practitioner to take in extraordinary cases, as much for the interests of science, which always gains by their study, as to render an account of the therapeutic indication which it presented. After this was done, we informed the parents of the young man that the extraction of these teeth would not only remove the sometimes painful obstruction caused by their presence, but that the space between the central incisors would also close in proportion to the shrinking of the alveolar processes, which their removal would bring about. We first extracted two, which were situated back of the other one, by means of straight forceps, which we were very careful to push as far up as possible, to prevent them from slipping. They gave way with great difficulty, in consequence of a backward curvature of their roots. We did not remove the third one till a month after; but as it projected much less than the others, we first loosened it by means of a lever, passed through the space presented by the small size of the right canine tooth, and finished its extraction with the forceps. Not more than two

months have elapsed since these teeth were extracted, and the space between the incisors is more than half closed ; and, as the alveolar processes are not yet reduced to their ordinary thickness, we are convinced that the lateral surfaces of these teeth will finally touch.

As they have taken a slightly oblique direction forward it is likely that we shall have to favor their retreat, by means of an apparatus such as we have described in that portion of our work devoted to dental orthopedia. But we are inclined to believe that nature will save us this trouble.

2. *Concealed Teeth*.—In the part which we have devoted to anatomy and physiology, it has been shown that the teeth are capable of being developed elsewhere than upon the alveolar border, and of remaining for a long time buried in the parts adjacent to the place which they should naturally occupy. These teeth, however, almost always ultimately make their appearance ; but the difficulty with which their eruption is effected is often troublesome enough to constitute a state of disease, and their presence is frequently the cause of phenomena the true character of which may be completely misunderstood ; cases of this kind have been related by Albinus,* Dessault,† Cavard,‡ Sabatier,§ and Laforgue. These cases are, without doubt, unknown to the authors who have written the most recent elementary treatises, upon dental surgery, since they make no allusion to them.

As the symptoms which indicate the presence of these teeth, generally, take their character from the place occupied by them, which is infinitely variable, and as the means adopted for their extraction should be in accordance with this fact, we will content ourselves by citing four cases, which, from their great dissimilarity, will give at once a general idea of the disorders which these teeth may occasion, the proper diagnosis, and the operations to which recourse should be had in order to give relief. The first of these cases is taken from our own practice, the second is from Laforgue, the third is extracted from Velpeau's lectures, and the fourth from Fouchard. In this last case the

* *De Sceleton Humano.*

† *Journal de Chirurgie.*

‡ *Traité d'Anatomie.*

§ *Médecine Opératoire.*

tooth had been buried in the tissues in consequence of the awkwardness of the operator.

Case 1. In 1828, a lady about thirty or thirty-two years of age, came to consult us about pain, sometimes very intense, which she suffered in all the left side of the superior jaw, and which had continued for six years, keeping her in a state of irritability which the slightest emotion transformed into a nervous crisis. Amongst the physicians who had visited her, some had pronounced this pain the result of some rheumatic affection, that sheet-anchor of many practitioners in doubtful cases ; others explained the case by saying it was a lesion of the fifth pair of nerves, against which no natural treatment could be successfully directed. What seemed to give some probability to this last opinion was, the fact that when the greatest exacerbation of the pain occurred, the hearing became obtuse and the face animated.

Tired out with the diversity of opinion, and especially with the failure of the treatment advised, this lady had consulted several dentists, who, at this period enjoyed the greatest reputation. None of them ventured to give an opinion as to the cause of the pain, and all, after a careful examination, had the good sense to refuse to remove one or any of the teeth which the patient begged, earnestly, to have extracted, but which nothing, presented by their appearance, to the gentlemen, authorized their removal. We were in all points of this last opinion, and the patient left us, as little satisfied, of course, with us as with the rest of those upon whom she had called.

We saw nothing of her for about two years ; but, in 1830, we recognised her, in company with a young girl, ten or twelve years of age who had been brought to obtain our opinion with regard to her two superior central incisors which seemed about to take a bad direction. We felt at liberty to make some inquiries of her in relation to the results of the painful affection of the face which had been the occasion of the honor of our first interview with her. She replied that the pain she then suffered had continued to increase, and that she had at last made up her mind to resort to one of those dentists *who do not reason*, and who complacently extract all teeth they are requested to extract.

We begged her to permit us to make a second examination. In examining the teeth on the left side of the superior jaw, we discovered that one of the small molars was missing; this fact had escaped us the first time, and this proves that in making examinations of this kind, too much care cannot be taken if it is desired to avoid the commission of injurious mistakes.

Then, turning our attention, carefully, to the alveolar border, we discovered that it was not only thicker than it is ordinarily, but that there was a hard and circumscribed tumefaction, which corresponded to a place between the remaining small molar and the first of the three large molars. From this moment we had no further doubt that this part of the alveolar border contained the missing tooth, and when we expressed this opinion to the patient, she desired that we should take steps without delay to make certain of the presumed fact. A slight incision was made with the bistoury upon the most projecting part of the tumor; the kind of resistance to the instrument, which we experienced, left no doubt, and authorised us to push our examination farther, and we soon discovered a small molar lying transversely with the crown forward. It was easily loosened with a curved lever, introduced between it and the posterior face of the teeth in front of it, and then extracted with a pair of curved forceps. The wound suppurated for six or eight days, after which it healed, and the pain disappeared permanently.

Case 2. In 1813, a man having a fibrous tumor situated in the middle of the roof of the mouth, came to consult Laforgue.* From time to time, a whitish odorless matter escaped from the side of this tumor which was about the size of an ordinary cherry-stone. A number of surgeons who had seen the case, were of opinion that the roots of the incisor teeth (still in place) either caused or sustained this affection. The crowns of these teeth were gone, having been destroyed by softening and caries. Laforgue removed three of these roots and left one, at the right side, which was firm and not at all painful. None of the roots presented evidence of being, either directly or indirectly, through their surrounding alveolar tissue, connected with the affection of the palate, which fact Laforgue communicated to the patient.

* *Dernier ouvrage cite, page 76, et Suivantes.*

Suppuration from the side of the tumor recommenced. This tumor was cauterized with the actual cautery twice in the space of ten days by Boyer. Pelletan was of opinion that it was a case of caries of the jaw; Dubois, that the remaining root was the cause of the continuance of the disease, and advised its extraction. Dupuytren was also of the latter opinion. Before leaving the patient, however, Dupuytren observed, that although the whole alveolar border was free from any indications of disease, it was thicker than is commonly the case after the teeth have been lost. He, accordingly, made an incision of the gum, over the part which projected most; this point corresponded with the alveolus of the lateral incisor of the right side; but he found neither fluid nor anything to direct his attention to the cause of the affection. The root was extracted by Laforgue, who discovered, what it was impossible to distinguish previously to its extraction, as it was almost covered with the gum, that it was the root of a small molar tooth. The condition of the alveolar periosteum and of the root, satisfied him that it was not the cause of the tumor of the palate. As he had previously extracted several roots, amongst which was not that of the canine tooth, which gave no evidence of its existence, and as the patient asserted, positively, that he had had none of the roots extracted, except by him; Laforgue was led to believe that the canine tooth was situated along the alveolar border. He told the patient, of his suspicions, and was begged by him to have a consultation with Dupuytren, which was agreed to.

The grounds upon which Laforgue came to this conclusion were, that, notwithstanding the loss of the incisor teeth and root, the alveolar border had not diminished in size, but, on the contrary, it was so much enlarged as to lead to the belief that some body was contained within it. The patient possessed a great deal of firmness, submitted himself into their hands and allowed them to make the necessary examination. The result was, that the canine tooth was found situated in the same place from which the roots had been extracted, but a little posteriorly.

The crown was toward the left side, the point touched against the alveolus of the canine tooth of this side; the root was turned toward the right side and behind the root of the small molar

which had been extracted in the morning; the external face was turned downward. The tooth was incrusted, about two-thirds of its whole length, and adherent to the maxillary bone. The extraction was effected with a pyramidal lever,* the point being placed upon the posterior face of the tooth; the triturating surface of the left small molar, which was supported by Dupuytren during the operation, was made the fulcrum. The operation was performed slowly and gently, without the production of much pain. All the effects of which it was the cause rapidly passed away, and the wounds healed without any other remedies than an emollient gargle used the first two days, and afterwards the *vin miellé*.

Case 3.† M. M——, an old artillery officer, living in one of the provinces since 1815, came to Paris for the purpose of placing himself under treatment for a syphilitic affection, which he had contracted during his campaigns, and of which he believed himself imperfectly cured. Several months before, an ulcer had formed near the base of the tongue, rendering very painful every motion of this organ. Mastication, particularly, was sometimes painful to such a degree that he was compelled to rise from the table without being able to eat. The mercurial treatment to which he was submitted by the most distinguished practitioners of the capital, far from curing the disorder, had the effect only of aggravating it; and the tongue, after fifteen or twenty days' treatment, was tumefied to such a degree as nearly to fill the mouth. The gums were engorged with blood, the breath fetid, and the teeth loose; the administration of mercury was entirely suspended, and the mouth, after sometime, reassumed the condition in which it was when M. M—— left his province.

At this time he called on M. Toirac, to get him to remove from his teeth the tartar which had collected upon them in considerable quantity; he spoke of his disorder, and related to M. Toirac what we have presented. This practitioner, after depressing the tongue towards the left side, by means of a spatula, perceived at

* The instrument, thus named by Laforgue, is the same as that generally known, as the *langue-de-carpe*.

† *Leçons cliniques de M. Verpeau*; tome iii., p. 385.

its base, the ulcer, resembling quite nearly, such as are generally attributed to syphilis; the circumference was swollen, and of a dirty gray color. The nausea which this caused the patient compelled him frequently to suspend his operations and the examination was, for this reason, very imperfect; this was not effected, indeed, until after repeated attempts; allowing M. M—— to rest from time to time; at last after a long examination, he succeeded in discovering upon the square portion of the lower maxillary bone, about six lines from the posterior dental canal, a hard body covered with a portion of the gum floating loosely and preventing him from distinguishing it perfectly. When this excrescence was removed, a piece of tartar was discovered, and taken away with a curved scraper. Under this, was another white body, which was found to be part of the crown of a wisdom tooth, imperfectly formed. This tooth, situated irregularly, came in contact with the base of the tongue and was the sole cause of the disease in question. Contending against the obstructions offered by the tongue, and the repeated nausea experienced by the patient, M. Toirac made many attempts to effect the extraction of this tooth; it broke, however, under the forceps, the only instruments he believed admissable in the case, but it broke, happily, in such a manner that the portion of root which remained, did not come in contact with the tongue. The patient was very promptly cured.

It is our opinion that, after the root was discovered, it would have been more prudent to have first loosened it with the simple lever, or with the *langue-de-carpe*, with either of which instruments it could certainly have been reached, as they are much smaller than the forceps, which were brought to bear upon it. By this preliminary precaution, the extraction would, perhaps, have been rendered more easy, and the necessity of leaving behind a root which might become the cause of future trouble would have been avoided.

*Case 4.**—"In order to show the great importance of not trusting to any but experienced persons in cases of consequence, I will relate here, the circumstances of the unpleasant condition

* FOUCHARD; *ouvrage cité*, tome i. p. 391, et *Suivantes*.

in which M. Henri Amanton, (son of M. Amanton, Esq., seigneur de Beurecœil, parish of Nonette, etc.) found himself in 1720, by having placed himself in the hands of a charlatan. This was done on account of a canine tooth which, in consequence both of its size and situation, was a source of much inconvenience to him : it was situated towards the internal face of the first small right molar of the upper jaw, and inclined considerably towards the palate. The inconvenience and pain caused by this tooth determined the gentleman to have it extracted ; and having made this resolution, he put himself in the hands of an operator, who, after placing him in what he thought a suitable position, applied a pierced key upon the extremity of the crown and then struck heavy blows with a stone upon the key ; by this manœuvre he forced the tooth almost through into the maxillary sinus and buried it so deeply that it was no longer visible. When the tooth had disappeared in this way, the empiric assured the spectators that the patient had swallowed it. This appeared plausible enough, as a search for the tooth was made in vain. Some time after, the patient experienced at this place, considerable pain, which induced him to consult his physician who found upon the cheek, near the nose, a small hard tumor, free from inflammation, and inside the mouth he discovered three very small fistulous openings which gave passage to a very fetid serous matter. Sometime after, two other fistulous openings appeared upon the tumor. Many consultations of the surgeons of Clermont, where the patient was conveyed, and at Paris, by M. M. Arnault and Petit, were held upon the case. These last named gentlemen examined the paper which contained a detail of the case, and perceived that it was sufficiently important to be treated with great care. They gave their opinion, which was sent to Clermont, but the surgeons of this city not having undertaken the case, either because it appeared too difficult or because they did not inspire sufficient confidence, and the patient came to Paris and placed himself under the hands of M. M. Arnault and Petit. These two surgeons soon relieved the patient of his troubles. After dressing the parts for ten days, M. Petit extracted the tooth successfully, which operation he performed by making an incision into the tumor, sup-

posing it to be occasioned by the extremity of the root of the tooth. Having discovered this root, he seized it with a pair of straight forceps and drew out the whole tooth. Finally, after a few days the patient was cured by ordinary remedies, without having his face at all deformed, scarcely indeed would one have supposed that an incision through the skin had been made.

Recapitulation of the Rules applicable to most cases of Extraction.

Whatever tooth or root is to be extracted, whatever place it may occupy, or whatever instrument may be used for this purpose, the certainty of the success of the operation is just in proportion to the precaution observed by the operator, first to take a sure hold of the tooth, and then to obtain a firm fulcrum for his instrument. It is particularly important to obtain a solid fulcrum, when the lever is used, for otherwise, it may escape from the part to which it is applied and wound the adjacent parts; the forefinger should be placed near the point of the instrument in order as it were to watch over its movements.

We have said that the tooth should be seized as far upon the root as possible, and the question now presents itself, whether it is necessary first to lay bare this portion, that is, whether the gum, which is adherent to the neck, should be separated from it and pushed upward or downward, as the case may be, to give place to the instrument. The older dentists never failed to take this precaution, which they regarded as the first step in the operation.* For this purpose they used an instrument which was called, and which is still named, *dechaussoir*; this was a steel shaft, solidly fixed in a handle, with a blade of some five or six lines, curved in the form of a crescent, cutting on its concave edge, and terminating in a point—in a word, the same instrument now used for opening abscesses situated far back in the mouth, and to incise the gums when they present an obstacle to the free eruption of the teeth.

This precaution is at present generally considered useless. Fox is almost the only author who has recommended it, and

*Voyez FAUCHARD; ouvrage cité, 2d vol., p. 130.

he advises the substitution of a common lancet for the *dechaussoir*, properly so called ; but we do not regard this as a happy substitution, especially as Fox does not mean the blade of a lancet fixed firmly in a straight handle. The reasons which have been given for the abandonment of this practice are, that if the tooth is only adherent by the gum, the slightest effort of traction, or turning over, wisely calculated, is sufficient to break up its adherence ; and if, on the contrary, the tooth is firmly set in the alveolus, the separation of the gum from the neck will not only do no good, but, in many cases, will disgust and alarm the patient, who is naturally disposed to judge of the pain of the operation by the preliminary. If the alveolus breaks, it is evident that the gum will quite as readily be lacerated, as if it had not been separated from the neck of the tooth. The same is the case with regard to the incision of the gums advised by some writers, for the purpose of uncovering roots to be extracted ; the practice is generally renounced, because it does very little towards exposing them, and occasions a flow of blood, which hides the parts upon which we wish to operate.

The lancing of the gum becomes, however, not only a useful but necessary operation, if it so passes the neck of the tooth that, in the perfect application of the beak or hook of the instrument, the operator would be obliged to seize them also, as this would cause pain, which would greatly aggravate that of extraction itself.

When the tooth is properly seized, and a good fulcrum secured, care should be observed in the manner of using the instrument employed. The practice of extracting the tooth rapidly, by a sudden and violent movement of the instrument, cannot be too much deprecated. We have seen such sad results follow this method of procedure, that we cannot express our disapproval in terms too strong. We will here cite a case from the last author to whom we have referred, as evidence of what may be the results of such a practice.

"Six years ago, I was consulted by a lady, who was suffering much pain from the results of the extraction of a tooth, which was done in a very rough manner. This tooth, the second inferior bicuspid, having been extracted with a violent effort of

the operator, two or three days after the cheek became much swollen, and an abscess was formed, which discharged itself through the alveolus of the extracted tooth. At this time we were called in, the pus was being discharged in abundant quantity, and the other bicuspid, which began to grow loose, soon became painful, and appeared to be a cause of irritation. I thought proper to extract it, and some time after there was exfoliation of several pieces of the jaw. The pain she suffered, however, did not diminish; the first molar, affected by the abscess, began also to grow tender. It was also extracted, and after the operation I was enabled to remove a large portion of the exfoliated bone. The discharge then ceased, and the affected parts were soon perfectly healed. In this case we see that three teeth were lost for one which was diseased, an exfoliation of the jaw, and six months' excessive pain, caused entirely by the imprudence of a surgeon, who had operated with a sudden and violent effort.*

We therefore repeat, that a tooth cannot be satisfactorily extracted, if its adhesion to the jaw is not overcome by a force which, increasing gradually, causes its attachments to yield without damage to the adjacent parts. It results, in consequence of a deviation from this principle, that accidents without number occur, that teeth are so frequently broken in their sockets, and that sometimes considerable fractures of the jaws occur. In operating, then, the degree of force used should be increased till the tooth is loosened, and an effort made, by raising the hand, to draw the tooth in a direction as nearly perpendicular as possible; in a word, less force than address should be used.

This is what is implied by Gariot, when he expresses himself as follows: "In the extraction of teeth, there is a physical principle which should not be lost sight of, that every time a body is distended more quickly than it yields, it will break. For this reason, the effort to effect the extraction of a tooth should be gentle, moderate, continuous and without the least sudden impulse. If this important observation is not lost sight

* *Ouvrage cité, page 257, et suivantes.*

of, teeth will rarely be broken, an accident which is of trifling character, but one which is sufficient to ruin the reputation of a dentist who may have much merit.* The ancients were so well aware of the wise moderation and address necessary to effect the extraction of the teeth, that they admitted and set down as a principle, that *forceps of lead* were sufficient for the purpose. This is attested by the instrument placed in the temple of Apollo, at Delphos, the knowledge of which, according to M. Duval, is due to Erasistratus, who lived about two centuries after Hippocrates.

If it is always important to refrain from rough and sudden violent efforts in the extraction of teeth, this necessity is particularly indispensable in those cases, which are quite common, where it is necessary to operate on the teeth situated in diseased tissues, or required to be extracted in consequence of some grave alteration, as in case of fracture of the jaw or resection of the bone. This is one of those exceptional cases, happily rare enough, in which any infraction of this rule would have very unfavorable consequences, and in which an inexperienced dentist would need great coolness to avoid the betrayal of his want of practice.

In the course of the year 1839, a woman of forty or forty-five years of age, stooped down to feed a hog, and speak to it. The animal rushed suddenly upon her, bringing its upper jaw in her mouth, and knocking inward twelve of the lower anterior teeth. This was impossible to be effected, but by a kind of separation of the alveolar border of the maxillary bone itself. A surgeon was called in, replaced the parts as well as he was able, without, however, fixing the teeth properly, and secured the whole with a bandage. The union of the alveolar processes was being effected in the position in which the parts had been placed, but the teeth, particularly the incisors, canine teeth and small molars, occupied such an oblique position, that they pushed out the lips, excoriating them, and giving to the physiognomy a hideous aspect. In this condition, the woman presented herself at the Hospital de la Pitié, in order to have this deformity corrected.

* *Traité des Maladies de la Bouche*, in 8vo, avec fig., 1805.

Professor Lisfranc, with whose particular friendship we are honored, desired that we should be called in. We went, and in the presence of the pupils and teachers, showed that it was proper that the teeth should be extracted, but by an effort of traction, in the direction of the line which they described, and not by any circular movement, which might have the effect of weakening, if not rupturing entirely, the cicatrization of the osseous parts, which had taken place underneath them. These teeth were, consequently, seized with the forceps, slightly loosened by lateral movements, a sort of counter-traction made upon those which were adjacent, as they came away singly; all were finally extracted with the greatest success, and much to the satisfaction of the professor, who took great pains to give evidence of that fact.

M. Lisfranc, also, sent us one of the inmates of the hospital over which he had control, for whom he had performed the operation of resection of the inferior maxillary bone, upon the stump of which a large molar tooth was still remaining; the extraction of this tooth, which had become necessary, required so much the more prudence as it was precisely at the alveolus of the corresponding tooth of the same jaw that the disease, for which the operation which was performed, had had its origin.

As to such teeth as, from their union with the jaw, or the conformation of their roots, can scarcely be extracted without being accompanied by some alveolar fragments, as it is excessively difficult, if not impossible, to ascertain their unfavorable form, and as the prognosis besides, would only intimidate the patient, it is impossible for the dentist to exculpate himself from the accusation of having, from want of skill, caused the pain which has been occasioned, by demonstrating that it was impossible to avoid the accident. Necessity and practice will, besides, point out certain expedients, belonging rather to the trade than the science, which will enable the operator to efface all evidences of the accident or to conceal it from the eyes of the patient who has been the subject of it.

Nothing now remains but to point out the steps which should follow the operation, always after the dentist is well assured, both by a careful examination of the mouth, and the root of the

extracted tooth, that nothing, which can cause future trouble, is left in the alveolus.

The first thing to be done is to allow the blood to flow for sometime before causing the patient to rinse his mouth. It is sometimes well to favor this flow of blood by lotions of warm water, particularly with persons affected with inflammations of the gums; in such cases the use of tonic, aromatic or acidulated gargles, should not be advised except in cases where the wound bleeds several hours after the operation.

Pressing the gums together with the fingers is a common precaution, directed rather by a desire to reassure the patient than by a positive indication, at least when they have not been greatly separated in the operation, or when a portion of the alveolus has not been broken. In the latter case the fragments should be removed; for this purpose the fingers ordinarily suffice, but it is sometimes necessary to use forceps with small beaks, such as we recommended for the extraction of roots. Finally, it will be prudent to direct the patient to guard his mouth for sometime against the impressions of the cold air, to avoid exercising suction of the gums, which might occasion excessive hæmorrhage, and for two or three days, from time to time, to wash his mouth with aromatic and spirituous lotions.

Of the Accidents which may Result from the Extraction of the Teeth.

Notwithstanding the assertions of some modern authors confiding, too implicitly, in the resources of the art, or, perhaps, too well satisfied of their own skill, the extraction of the teeth is sometimes followed by accidents which the most prudent and adroit dentists cannot possibly avoid, because they are dependant upon certain anatomical irregularities of which there is no external indication, or upon some casual circumstances against which the wisest foresight will find itself entirely at fault.

These accidents are of three kinds: they either result from a general derangement of the economy caused by the operation itself or the preparations for it; or it consists in the fracture of the tooth to be extracted; or, finally, it depends upon some lesion, of the adjacent parts, as the bruising or lacerating of the gum—

excessive hæmorrhage—denudation or fracture of the alveoli—the loosening, luxation, fracture or complete extraction of the adjacent teeth—the fracture of either jaw, or the luxation of the inferior jaw.

General or Nervous Accidents. The teeth are, constantly, exposed to diseases from so many causes that few persons have the privilege of escaping the operation of their extraction; and amongst the numerous class which has been forced to submit to it, there are none who have not been forced to conclude that no skill of the operator or perfection of instruments can guarantee it from being painful. But, on the other hand, the pain produced, (sometimes very acute, and bearing a peculiar character,) is almost always of but instantaneous duration; so quickly over, in general, that it is often a source of regret to the patient, that he has hesitated between dread of the operation and the desire to be rid of the diseased tooth.

There are cases, however, in which this pain is of longer duration and becomes the cause of nervous accidents, well calculated to alarm the inexperienced practitioner. These we have known often to occur with very nervous persons, particularly females and children. Sometimes a long fainting fit is produced, sometimes a general tremor, a general attack of the nerves, and indeed, epileptic contractions or true tetanus; these effects may, in some cases, cause in females a suppression of the menses and even produce abortion. This latter effect is, however, of such rare occurrence that pregnancy does not contra-indicate the operation, as we have already said in opposition to the opinion of M. Oudet, particularly when this operation seems to be the only means of relieving intense and obstinate pain. We are surprised to perceive practitioners partaking of this prejudice, which was formerly opposed by Fauchard and Bunon. Fauchard says, with regard to this matter: * “We often see women and nurses, tortured with very acute pain, in consequence of carious teeth, and we do not hesitate to extract them, notwithstanding their pregnancy and the vulgar opinion, that injury may result from it;” and Bunon: † “This letter encourages me to give a disserta-

* *Ouvrage cité*, tome, 1, p. 202.

† *Exper. et Demonst. Faites, etc., Pour Faire Suite à l'Essai sur les Maladies des Dents*, 1 vol. 12mo, 1746, page 62.

tation upon the teeth of pregnant women, in which I will show the infinite injury which results both to them and their offspring from the dangerous prejudice against touching the teeth of women who are *enciente*.*

If the operator is unable to avoid the production of pain, he can, at least, render the necessary preparations less frightful, by assuming a gentle and encouraging deportment; for, in good physiology, it will be easy to prove, that without dread of the operation, which has an unfavorable influence upon the brain, the nervous accidents attendant upon the operation will not occur, or if they do, will be so mitigated as to be of trifling consequence. But it is particularly the case when the operator fails to accomplish his purpose at the first attempt that all subsequent efforts produce alarm; it is, therefore, important not to disdain any precaution which will insure the success of the first trial, and it should never be forgotten that of these two precepts of operative medicine: *citō et tutō*, (promptly and surely,) the first is always to be sacrificed to the second.

There are besides certain moral characteristics which should make it a duty with the dentist to refrain from operating; these he should early accustom himself to discover, to avoid the embarrassment which would result from an imperfect or very painful operation. Having stated that fainting and syncope is sometimes a result of the extraction of teeth, it follows that the office of a dentist should be supplied with bottles of volatile salts, which are used generally under such circumstances.

Fracture of the Teeth.—As we have already stated, a tooth, in the course of the operation of extraction, may, from a variety of causes be fractured: this may occur because the whole of the interior crown of the tooth is so much destroyed by caries that it cannot bear the pressure of the instrument; or because the roots are longer than was suspected by the operator, not so strong as the alveoli, and convergent, embracing a considerable portion of bone, or bent inward in the form of a hook, or finally effected with exostosis, a case of which, we will presently relate; or

* These two quotations prove that M. Begin (*Dictionn. et Mot cités*) is mistaken in stating, that these two authors greatly dread the extraction of the teeth of pregnant women.

because the operator has either made use of an improper instrument or has fixed the fulcrum too directly in face of the power, which then, rather crushes, than raises it; often too, in consequence of the patient having pushed away or grasped the instrument or the hand of the operator just when he was about to use it.

Gariot regarded the fracture of a tooth as a trifling accident; we do not agree with him, not so much because it may have the effect of injuring the patient, as because serious consequences may result from it. The presence of the root of a tooth, after its rupture, may cause insupportable suffering, and it is not always possible as Fournier,* has, with reason, remarked, to find a dentist sufficiently practised to extract this root when it offers no hold for his instrument, is irregularly implanted in the socket or malformed. This physician had some sad experience of this fact, for he declares that for three years, he carried the root of a tooth which caused him indescribable suffering. He thus recounts the event which placed him in this uncomfortable condition.

“A dentist who desired to give me a proof of his dexterity and the *rapidity* with which he extracted teeth, broke off one of mine; it was the dens sapientiæ of the lower jaw: the wretched fellow attempted, but vainly, to extract the root, and men, justly celebrated for skill in their profession, also attempted it unsuccessfully.”

M. Catalau, finally relieved him of it. But it must be said, in justification of the dentist, to whom Fournier had recourse, that the tooth was rendered more difficult of extraction because it was implanted obliquely in the jaw, and one of the roots was affected with an *enormous exostosis*, and was curved backward towards the coronoid process.

When the fracture takes place above the edge of the alveolus, so that it can be seized by an instrument, the attempt to remove it should be the same as if it were a sound tooth, upon which no attempt at extraction had been made. In the contrary case, when the fracture is below the edge of the socket the dentist should proceed just as he would have done if he had been orig-

* *Voyez le Mot Dent, déjà cité, du Dictionnaire des Sciences Medicales.*

inally called upon to extract a root of the same character, at least if the portion remaining is not too small or too deeply buried in the socket. If it is a root which has been a long time deprived of its crown, that is the subject of the fracture, and it is soft and friable as is often the case with the anterior teeth of the lower jaw, it should be removed by the lever, piece by piece, if it should break.

It often happens, as we have already stated, that every portion of the root of a fractured tooth cannot be extracted; in such case we would advise the use of emollient and anodyne fomentations, relaxing drinks, foot-baths, and wait till the time when nature will have effected the destruction of a part of the alveolus, detached the gum and exposed the root, when its extraction will be quite easy; it is not rare either that two or three days after the accident the remaining portions remain loose in the alveolus and are more easily extracted than they would have been on the day when the accident occurred. If, at this time, the extraction is not more easy, and yet the pain continues, the root must be removed without delay.

Bruising and tearing of the Gums.—*Sympathetic Lesions of various kinds.*—Bruising of the gums is the inevitable result of the action of all those instruments which make a fulcrum of the alveolus, such as the key of Garengéot and the pelican; and tearing of this tissue is a common consequence of a rupture of the alveolus. If the key is used, that part of the gum, only, corresponding to the extracted tooth, is liable to be bruised or divided, if, on the contrary, the pelican is employed, bruising of the gums of the teeth, adjacent to the one to be extracted, upon which it is necessary to let it rest, and tearing off the gum of the extracted tooth is liable to take place.

The question now presents itself, as some practitioners, and among them Malgaigne* advise, when it is perceived that the gum is being torn, should the extraction of the tooth be completed as quickly as possible? We are not of this opinion, for in operating with rapidity a much larger portion of the gum is liable to be removed than would otherwise occur. It is much better, we

* *Ouvrage cite*, p. 115.

think, to use the gum lancet, and limit, by an incision with the blade, the portion which should be sacrificed. The self-love of the operator, may thereby suffer, but it is his conscientious duty to pursue this course.

However serious the disorder which follows either of these accidents, may appear, at first sight, in most cases there is no very bad result to be apprehended. The use of Cologne water or any similar article which is commonly given to patients, to rinse the mouth immediately after the extraction of teeth, generally, is almost always sufficient to effect the resolution of bruised gums, or the retraction of the divided parts. If inflammation of the parts is threatened, it is necessary to attempt to prevent it, and if this is not possible, to combat it by the appropriate means which we have indicated in many portions of this treatise. As the disorders produced by this cause are ordinarily local, they are generally easily managed. But sometimes the neighboring parts, as the lymphatic glands of the neck, the sublingual and maxillary glands, and even the eyes and the mucous membrane which lines the pharynx, and the nasal fossa, are affected. A young man once applied to us, to have extracted one of the first molars of the upper jaw ; he was affected with lachrymal fistula, resulting from the obliteration of the nasal canal, which, he assured us, occurred in a few days after the removal of the canine tooth next to the small molar we extracted, and corresponding with the diseased eye. An examination of the remaining eye-tooth, led us to believe that the root of this tooth, also, was too long to allow of its removal without the production of some disorder.

To the accidents above enumerated, which may happen to the soft parts adjacent to the teeth, may be added : shocks to some of the branches of the inferior dental nerve, besides those immediately belonging to the extracted tooth ; from which paralysis of the lip may result. A case in point is found in the works of Sir Charles Bell ; it is reported by M. Jobert, as follows :* “A man for whom had been extracted a molar tooth of the inferior jaw, whenever he put a glass of water to his lips, experienced a sen-

* *Ouvrage cite*, tome 1, p. 186.

sation as if the glass were broken, when he could readily see that the impression was erroneous. This phenomenon was accounted for by supposing that the man had lost the sensibility of one-half his lip although it still retained its power of motion. After the extraction of the tooth he was unconscious of the presence of any substance coming in contact with the paralysed lip. Charles Bell attributed this paralysation to some injury of the nerve passing through the dental foramen, which as is well known is a branch of the inferior dental nerve.

We are inclined to think, too, that the deafness often resulting from the extraction of certain teeth, is caused by a lesion of the maxillary nerve, which, it is known, communicates by some branches, with the internal ear. We knew of a man, in the prime of life, who had one of the first large molars of the inferior jaw, extracted; the operation was difficult in consequence of the abnormal conformation of the roots, and a part of the alveolar wall was broken. Some hours after the extraction of the tooth he experienced a humming in the ear, and in less than fifteen days he lost entirely the faculty of hearing on that side. As the man was of a plethoric habit, the physician, whom he consulted, did not for a moment suppose it was any thing more than a congestion of the lining membrane of the cavity of the tympanum, propagated along the Eustachian tube; he advised bathing of the feet, revulsive purgatives, and afterwards, the application of dry cups, and then scarifications of the nape of the neck and the skin back of the ear. But all was useless, the hearing on this side was gone entirely and without return. What is still more extraordinary, the same man, after two years had elapsed, was compelled to have the corresponding tooth of the same jaw extracted, after having suffered horrible anguish for a long time in the fear of a new misfortune; the same result ensued.

M. Toirac, has related a similar case in a brochure, published in 1829,* but as he became acquainted with it from the statement of the patient, he has, consequently been able to present it

* *Memoire sur les diverses espèces des deviations, dont est susceptible la dernière molaire, et sur les accidents qui peuvent accompagner sa sortie.*

only indirectly. He gives it as follows : In 1819, I saw a man attending the clinique of Professor Roux, of the Charité Hospital, who complained of deafness in the left ear, which had resulted from the extraction of a second molar tooth of the same side. Three months after, he returned and apprised us that he had lost the use of the other ear in consequence of the extraction of the corresponding tooth. I know that in this patient, of whom I have lost sight, each operation was followed by excessive inflammation.

These accidents have been observed by Monteggia,* who thus alludes to them : "When the dental nerve is bruised or ruptured, spasms of the face and deafness, or paralysis of the muscles of the inferior lip and chin, may ensue, in consequence of the communications of this nerve with the portio dura of the seventh pair." M. Bossi has observed the injurious consequences of a lesion of the nerve, in fractures of the inferior jaw ; he proposes to displace the fragments, and introduce a bistoury to cut the dental cord.

Doctor Valleix also, in his treatise upon neuralgia, relates many cases of trifacial neuralgia, which could be traced to no other cause than the effects of the operation which now engages our attention. "The first symptoms of this affection," says he, "in a patient who had never before suffered from neuralgia, developed themselves a quarter of an hour after the extraction of a canine tooth, which was affected with simple odontalgia ; in this single case, we meet with a very evident occasional cause of this disorder, showing that it proceeds not from *caries*, but *extraction* of the tooth.†

In a treatise upon dental medicine, published in England, in 1823,‡ we find a case of facial neuralgia, of which the translation is as follows : A young lady, living at Plymouth, was brought to me by one of my friends, Dr. Mudge ; she was about eighteen years of age, and, about two years previously, had undergone a serious operation. The right superior molar tooth

* *Instituz Chirur.*, tome 5, p. 54.

† *Traité des Neuralgies* ; 1 volume in 8vo, 1841, p. 145.

‡ A Practical and Domestic Treatise on the Diseases and Irregularities, etc., chap. xviii, p. 80.

having become painful, and given reason to believe that it would injure the adjacent teeth, she desired to have it extracted. The operation was performed by the family surgeon ; a large portion of the maxillary bone was unfortunately fractured, and, having been disengaged from the adherent gum with great difficulty, the two adjacent large molars, the roots of which seemed to be interlaced with each other, came away, with a large piece of the bone. The young lady, who had a good constitution, was restored to health by the attention of Drs. Mudge and Gaskyne, but, unfortunately, the result of the accident was a gradual contraction of the muscles of the cheek, under the eye, which caused a disagreeable deformity of this part of the features."

Besides the various accidents which may result from the extraction of the teeth, there are others, which may be the consequence of the improper application of the instrument, which, instead of affecting the tooth itself, produces some injury of the adjacent parts ; Lecourtois* cites an instance of a dentist, who, in making use of the davier, tore away a large portion of the inner part of the cheek ; and of a surgeon who, in extracting a stump with the punch, wounded the sublingual artery, thereby causing a very serious hæmorrhage. The first accident is very liable to occur to practitioners who are unacquainted with the use of the *pied-de-biche*.

Denudation and Fracture of the Alveolus.—What we have said with regard to the mode of action of the various kinds of instruments used for the extraction of the teeth, will make it plain to every one, that accidents of the two kinds specified above, will be of common occurrence with operators who almost exclusively make application of the key of Garengéot and the pelican ; and what we know of the form of certain roots, shows, too, that no instrument is sufficiently perfect to effect their extraction without some injury of the alveolus.

When simple denudation of the alveolus occurs, it is rarely that any serious consequences ensue, the cicatrization of the gum is soon effected. But when the alveolus is fractured, and a fragment of any considerable size has come away with the

* *Le Dentiste Observateur, ou Recueil d'Observations*, in 12, Paris, 1775.

tooth, inflammation almost always supervenes, and this may be sufficiently serious to confine the patient to his bed. It may be readily conceived, when this accident does occur, that address must be used promptly, to detach the fragments of bone from the tooth, before showing it to the patient, who would be alarmed by it, and judge unfavorably of the operator; but if the adherence of the alveolus to the tooth is so great as to form true ankylosis,* so that the patient can be made to understand it, it is better, without circumlocution, to explain to him that the obstacles to its perfect extraction were in this adhesion, and not in the manner of operating.

The fragments of the fractured alveolus do not always, however, come away with the tooth. If these fragments are very large, they may be attached to large portions of the gum; it is necessary, in such case, when it can be done, to separate them; for, in tearing away the piece or pieces, a large portion of the gum, covering uninjured parts, is also liable to be removed, an accident which might occasion exfoliations more or less considerable. There are cases, however, in which it is impossible to effect this separation; as when a large mass of the alveolus is adherent to the root in its whole length, or is fractured, and comes away with it, as we have shown. This often happens with the last large molars, particularly of the superior jaw, where it is always difficult to operate, either to luxate the teeth, or to separate the gums, whether the operator is contented simply to turn them out of their sockets, or to detach them with a cutting instrument.

In the latter circumstance the operator will require all his coolness, for the patient, giving way to the pain, loses patience, and complicates and prolongs the operation by his movements. He should hasten to terminate it, the forceps with which he seizes the luxated tooth, will enable him to make a lateral movement in drawing it, and will tear the gum as little as possible, at least if he is operating upon a patient not sufficiently docile, to permit him to make the resection with a gum lancet. This

* See our fourth page, where it will be seen what is meant by an adherent tooth.

loss of substance has, rarely, injurious consequences, which can give reason to dread these accidents which may occur to complicate the operation of extraction.*

The slight importance, generally, of these accidents does not render it less prudent to advise persons who are the subjects of them to avoid placing themselves in circumstances which may have a tendency to aggravate their results. Such as exposure to severe cold, and more particularly, sitting in a draught of air. There are many facts in our possession which prove that this precept is not one of those unimportant recommendations, which are often insisted upon to give more importance to the operation performed, but is one which experience and reason demonstrates it would be wrong to neglect. We, here, present one of these facts :

In 1837, a rich farmer, in the environs of Paris, suffering from caries of the second large molar of the inferior jaw, applied to the physician, in his vicinity to have it extracted. The operation was performed, as may be suspected, with the key of Garengeot, a favorite instrument with surgeons who think of their own convenience, more than they do of the good of the patient. The pain experienced was violent, but the patient never having had a tooth extracted before, did not suppose he suffered more than is usual, and attaching no particular importance to his case, set out the same day upon a journey of many leagues, in an open carriage exposed to wind and rain. On reaching his destination, he perceived his cheek swelling, and felt the approaches of fever to such a degree that he was compelled to take his bed ; the next day the swelling of the cheek, which was at first confined to the region corresponding to the part upon which the operation had been performed, had extended to the whole of the side of the cheek, and, either because the inflammation had extended to the skin of the scalp, and thence to the dura mater, or because the brain became affected in consequence of the excessive pain, delirium supervened. The physician who extracted the tooth was sent for, and by a copious bleeding

* See what we have already said, in relation to fractures in the pathological part of our work.

from the arm, the application of opiate cataplasms to the affected cheek, and frequent sinapised foot-baths, succeeded in arresting the progress of symptoms which, if left to themselves, would infallibly have terminated fatally. The cheek, however, remained swollen and painful for more than a month. Some persons persuaded the patient that the continuation of these symptoms might proceed from some portion of the root of the tooth still remaining in the socket, and he determined to consult us with regard to it. Having attentively examined the place, from which the tooth was removed, we found, not a portion of the root, but, a long fragment, which had formed the anterior wall of the alveolus and which had been fractured. The eliminatory process which its presence had caused, having sufficiently detached it from the subjacent parts, we shook it slightly for several days in succession, and, at last, removed it without any serious consequences.

The consequences of disorders brought on by the extraction of teeth under the circumstances of which we have spoken, may, indeed, have a termination infinitely more serious; sometimes we have known death to result, as is shown by the following case which we take from the English treatise, from which we extracted the account of the case in another place.

“A merchant of Plymouth, travelling on business, stopped at Kingsbridge, Devonshire. Whilst he was tying his horse he was suddenly attacked with a violent tooth-ache. The landlord of the hotel, at which he stopped, told him that a young man, in the employ of the druggist of the place, had been very successful in the extraction of teeth, and the pain increasing, he called upon the young surgeon and requested him to remove the offending tooth. The latter, without examining the condition of the tooth, or the circumstances of the traveller, had immediate recourse to his instrument, which was the only one he possessed and the best that could be found in the country—he placed the patient on the ground and operated with violence. The affected tooth was the first large inferior molar, to which, when it was removed, a large portion of the alveolus adhered. The traveller continued his journey without having been advised to take those precautions which his situation demanded: he had about

seven leagues to travel on horseback, and the weather was very wet and stormy. Shortly after he started, the loss of blood was so considerable that he was compelled to stop at a tavern, which he found on his way, to procure a little brandy with which he rinsed his mouth and which somewhat palliated the painful symptoms. He then continued on his way and reached home at about half past nine in the evening. His jaws and head were considerably numbed with cold, and much swollen, in addition to this, symptoms of fever were present and the jaws were much stiffened. The next day a physician was called in. At this time all the alarming symptoms increased in intensity, and there was apprehension that a spasmodic occlusion of the jaws and even gangrene would supervene. The condition of the patient, in the short space of twenty-four hours became quite alarming, and the efforts of the physician were unavailing; at the age of thirty-two years, with a robust and healthy frame, this patient died the sixteenth day after the extraction of the tooth."

Here terminates all that relates directly to the precautions which we regard as necessary to be observed: but the close of this case conveys a precept relating to the unnecessary extraction of teeth, which is too important to be omitted. "The widow of the deceased, who related to us the particulars of this unfortunate affair, showed us the tooth, which she had found in the vest pocket of her husband. On examination, we found that it was very slightly decayed; there was a small cavity on the grinding surface, into which a small hard substance had been pressed, causing, doubtless, the pain which he experienced in dismounting from his horse at Kingsbridge. If this substance had been removed from the cavity, and a small point of the crown of the opposite superior molar pressing upon it had been filed away, the pain might probably have been relieved by applying a little spirit to the part, and in place of extracting it, the man and the tooth would probably been in existence till the present day."

Hæmorrhage.—When the extraction of a tooth has been successfully and properly effected, the flow of blood which follows is almost always spontaneously arrested. In the majority of cases, it is not only not necessary to arrest this bleeding suddenly,

but it is important that it should be favored, as it relieves the turgid vessels of the gums and prevents subsequent inflammation. Sometimes, unfortunately, this flow of blood, trifling at first, continues and increases in quantity till excessive hæmorrhage ensues. This result, which may become of more alarming character, than any which ordinarily follows the extraction of a tooth, is less apt to be caused by the simple extraction of the tooth itself than by the various accidents which we have been engaged in specifying;* it may even result in the death of the patient, as will be seen from the case which we cite below; many cases of a similar character have already been recorded by writers upon our science.†

If hæmorrhage proceeds from one of the sockets of the front, and especially of the teeth of the lower jaw, it is generally quite easy to arrest it. To accomplish this purpose it is sufficient to introduce into the bleeding cavity, a piece of cotton or a substance of a similar character, saturated with some styptic, and force it down with a plugging instrument. Success may also be readily obtained by filling the bleeding cavity with soft wax, and pressing it firmly in its place by closing the jaws. This means of arresting hæmorrhage is especially useful when it proceeds from the upper jaw, as by entering into all the anfractuositities of the alveolus, it fills it completely and retains itself in its place. A surgeon furnishes a case in the transactions of the Royal Academy of Surgery, in which this means was resorted to.‡

“Having attempted twice, fruitlessly, to arrest a hæmorrhage with pledgets of cotton, saturated with Rabel water, the general principle applicable to the case occurred to him; first of all, fearing that fragments of bone might be the obstacle, he examined the condition of the parts and discovered a portion of tartar, which he removed from the socket, he then employed a plug of soft wax, which he forced down with address, in all the alveo-

* Calsus regarded excessive hæmorrhage as an invariable sign of fracture of the alveolar socket, and even of the maxillary bone.

† See CARDAN, *De Causis et Signis Morborum*, page 155.—PLATER, lib. iv, case 35.—S. H. *De Virgiliis Biblioth. Chirurg.* page 782, ex. J. D. SCHLITING.

‡ See these transactions in 12, tome ix. p. 237.

lar cavities, thus bringing pressure to bear upon the mouths of all the arterial branches. This means was followed by the most happy success, and thus was saved the life of a man already much weakened by loss of blood and threatened with approaching death."

But there are other circumstances under which a hæmorrhage of this character is infinitely more difficult to arrest, as, for instance, when it proceeds from the socket of a molar tooth, and especially the wisdom tooth of the upper jaw, when the remaining molar teeth are in their places; when the roots of the extracted tooth show that the cavities are very deep; when the socket has been fractured, with loss of substance and the gum torn; when the gums were engorged with blood, before the operation, and when the patient presents those characteristics of scorbutic cachexia, which we have described in another place; in this last case, indeed, the hæmorrhage may return, after having once been arrested, as the slightest cause is sufficient to set the vessels bleeding again. In order to arrest a hæmorrhage, complicated by any of the above named circumstances, the following steps must be taken; in the first place, care must be taken to ascertain the exact place from which the blood flows, and to assist the accomplishment of this purpose, the coagulated blood around the open vessels, or buried in the depths of the socket, must be removed; then pledgets of cotton dipped in vinegar, or in some of those *hemostatic waters*, which have made so much noise of late, and of which the useful ingredient is alum (sulphate of alumine,) should be forced down into the bleeding socket; a lateral compress should then be formed by placing between the gum and cheeks, pieces of cotton, thick and flattened so that strong pressure on the gums can be made; the two jaws should then be brought together so that the lower may exercise pressure upon the upper; care should be taken to fill any space which may be left opposite to the bleeding socket, in consequence of a loss of teeth. Sometimes it may be useful to apply a compress upon the face under the cheek bone, as this will bring pressure to bear upon the base of the apparatus; the jaws should be retained closed by means of a bandage passed around the head and chin. This apparatus should be kept in place at least three

or four days, if not longer. The cotton should only be removed and renewed, when it is necessary to dress the wound.

Some practitioners find it more certain, or at least more expeditious, to have recourse to cauterization, performed either with the red-hot iron or with a concentrated acid.

We will not repeat what we have said, elsewhere, of the inconvenience and even danger of this remedy, (especially the last,) the employment of which requires skill and the greatest circumspection. We will be satisfied with observing, that the cautery is an extreme remedy and is only applicable to those cases where the exact point of the alveolus from which the blood flows can be seen, and the jet of blood renders apparent the mouth of the vessel which furnishes it; it would be entirely irrational to resort to it when the hæmorrhage proceeds from the lacerated gum or from the alveolo-dental membrane; it is best then to use compression; this means, however, is not infallible as is proven by the following case taken from an English journal, the "London Medical Gazette."*

A gentleman of middle age, quite robust, had the wisdom tooth of the right side extracted on the 19th December, 1841. The extraction was made with a pair of forceps of the kind generally used for removing the temporary teeth. The bleeding was not remarkable, and was readily arrested by means of a compress upon the alveolus assisted with cotton dipped in camphorated brandy. At half-past four in the evening the bleeding returned; it emanated from the cavity of the anterior root in great abundance, and in all probability from the alveolo-dental membrane, and not from the central artery of the pulp, as no jet could be discovered. The compress already applied was removed and the cavity cleaned out, washed, a new compress applied, and carried down more forcibly than the first, by means of a curved instrument; above the compress, a plug was applied, which was strongly compressed between the two jaws—a bandage kept the jaws together. The bleeding was arrested for the time, but re-appeared; it was again arrested and again returned, and thus it continued for three weeks, night and day. At the

* February, 1842.

end of this time the patient had become so weak that he died from anemia, in spite of the effort of many physicians." This account is followed by a detail of the means to which they had recourse.

Although the means we have indicated are very rational, we think they might, very often, be substituted by a long continued application of the finger and thumb to the alveolus filled with cotton; in the same manner that the bleeding of a leech-bite is stopped by pinching up the skin. One of us was called in to a case of similar character, at Varsovre; the patient was the wife of a Jew banker, and had been abandoned by the dentist. We succeeded in arresting the hæmorrhage by holding the finger for a long time applied to the bleeding alveolus, and compressing, from time to time, the whole thickness of the jaw, down to the level of the alveolus. This mode of compression was known to Van Swieten,* who declared that he had witnessed the most happy results from its use.

It must not be supposed that the teeth most firmly implanted in their sockets are the only ones the extraction of which is likely to be followed by hæmorrhage. Valeriola† mentions the case of an old woman, for whom he extracted a carious tooth, *with his fingers and without effort*, who experienced a hæmorrhage, which continued three days before it was arrested; before this time, however, she did not call in the assistance of any one. The cases, unfortunately, are not very rare. We recollect the case of a man, thirty-five years of age, for whom, with the forceps, and with great ease, we extracted a first superior molar, deeply decayed, and for a long time loose; hardly was the tooth out of the socket, when great hæmorrhage ensued, and the ordinary simple means having failed, we were obliged to apply a compress.

It is important to know that hæmorrhage after the extraction of teeth does not occur immediately after the performance of the operation. We have seen it occur after the lapse of seven, eight and twelve hours, and not be less alarming on that account.

* *Comment. in Aphor.*, BOERHAVII, § 248.

† *Memoir de l'Acad. Roy. de Chirurgie*, tome vii, p. 40.

Here we give a case, in proof of what we say, in addition to that which we extracted from the English journal.

In 1833 or '4, we extracted a first inferior molar for a young man, of about twenty-four years of age. The operation, without having been very painful, was difficult, in consequence of a backward curvature of one of the roots, and a portion of the alveolus was necessarily broken. The quantity of blood which flowed from the alveolus, during the quarter of an hour that the young man remained in our office, was not more than usual; the gum was uninjured, and we saw no indication of a scorbutic constitution. In the middle of the night, fifteen or sixteen hours after the operation, the mother of the young man came in great alarm, to beg us to come to him, as, ever since evening, he had been losing blood from his mouth in great quantity. We found him in his bed, literally bathed in blood. After getting him to rise, we examined the alveolus, by removing the coagulated blood, and, perceiving no arterial jet, we applied to it a number of bits of cotton, saturated with vinegar. The blood continuing to flow, we placed his feet in sinapised water, and ordered him to remain in a standing position; we then replaced the cotton saturated with vinegar, with others which were sprinkled with powdered alum. The patient fainted, but soon recovered, and the blood ceased permanently to flow. Three or four days after, he called upon us, having already recovered from the weakness occasioned by the loss of blood.

Injury to the Adjoining Teeth, and their Replacement.—1st. The loosening, luxation and even complete fracture of the teeth adjoining the one we wish to extract, or which has been extracted, are accidents which may occur in many cases—for instance, when the patient displaces the instrument, by seizing the hand of the operator; when the hook is too large, and encroaches upon a tooth next to that which is to be extracted, to which its action should be confined; when it is not placed precisely in the middle of the tooth; when it has been held obliquely, and when, in the luxation, it has encroached upon its neighbors; when the adjoining teeth are weaker than the one to be extracted; and, their alveoli fractured, at the same time leaving them denuded; when the pelican is used for the purpose of extracting

the large molars, and a fulcrum is made of the weaker small molars; finally, when the operator mistakes the seat of the disease, and extracts a sound tooth for the diseased one; or, in attempting to extract one, two, which are united, as in the case related by Fauchard,* are removed

Sometimes, as is most commonly the case, the accident is confined to a single tooth; sometimes, on the contrary, two are subjects of it, as in a case we saw about a year ago, in which an attempt was made with the key of Garengéot, constructed with the pretended improvement of Maury, a fulcrum being made of the two small molars in front of it. Sometimes we have known even three teeth to be forced out with the one which was to be extracted. These accidents, the last particularly, were of much more frequent occurrence at that period when the pelican principally was used in the extraction of teeth, with which instrument the slightest want of skill was liable to produce disasters of the gravest character; this is proved by the amusing but unfortunate case related by Ambrose Paré, of the servant of a dentist of Orleans, who, in attempting to extract teeth, like his master, *with this instrument*, extracted, besides the bad, three good ones.†

The operator should earnestly endeavor to avoid the causes of these various accidents. He will almost always succeed in this, by adhering to the rules which we have recommended as being the best in theory and practice. If, however, contrary to expectation, any one of them should happen to him, he must hold himself ready to make the best of it. If a tooth is simply loosened, he must direct the patient to avoid using the jaw for several days, so that it may recover its usual firmness; if it is completely luxated, he should replace it, and keep it fixed, as we have directed, when treating elsewhere of luxation; means

* Ouvrage cite, tome i, p. 342.

† "But in place of extracting the bad tooth of the poor villager, he removed three good ones. Experiencing extreme pain, and seeing three of his teeth out of his mouth, he began to cry out against the Picard, who, in order to silence him, said to him, he had better be quiet, for if his master came in, he would make him pay for three teeth instead of one."—*Œuvres d'Ambrose Paré*, livre xvi, chap. 27.

known to Hippocrates, who advises, for the purpose, threads of gold or silk.* If, on the other hand, it is fractured, the operator is to act as in any other case of ordinary fracture.

Besides the three kinds of injuries which the teeth adjacent to the one we are desirous of extracting are likely to suffer, (viz. loosening, luxation and fracture,) there may yet occur, as we have already intimated, one of a more serious character, *i. e.* their complete extraction. The only method of procedure, in such case, is immediately to replace the tooth which has been accidentally extracted, and keep it in place, in the same way as with a luxated tooth. We advise this, for the purpose of reassuring the patient, and to make the accident appear less serious than in the conviction that a tooth in this situation *will recover its original firmness*, as appears to be believed by Maury, M. M. Lefoulon, Delabarre and many other modern authors.

A person named Dupont, in a pamphlet, published in 1633, entitled "A Remedy for Tooth-ache," was the first who established as a rule the immediate replacement, of an extracted tooth in its socket, and he was of opinion that it would not be long before it contracted new adhesions, to the walls of the alveolus. Fauchard was fully of the same opinion, as is proved by the following sentence: "It should not be unknown that the teeth after having been extracted, will again become firm in their sockets, if they are immediately replaced." Dionis and Verduin, however, who were his contemporaries, maintained and demonstrated the contrary. Finally, Monton,† in 1786, endeavored to give new credit to this opinion of Fauchard, which many dentists, even M. Duval, dared not formally oppose; this practice was adopted by Benjamin Bell on the faith of Hunter and Callisen, as is proved by the quotation which we have presented on another page, from this author, as also one which we will make presently.

Our own experience has demonstrated to us, many times, that

* This is the only case in which Hippocrates has specified the use of these two species of ligature, although they were evidently known before him, as we will demonstrate in the chapter devoted to dental prosthesis.

† *Essai d'Odontotechnie.*

teeth thus replaced, act as nothing else than foreign bodies, which have no other advantage than to fit down exactly into the socket ; but it is not long before they are lost by decomposition or the absorption of their roots. Often, indeed, before this decomposition is effected, they are the cause not only of disagreeable fistules, difficult to cure even after the extraction of the teeth, but, also, as is attested by Richerand, they may occasion other serious affections, such as caries of the jaw, obstinate odontalgia, and even convulsions which have only been relieved by their final extraction.* The following case proves the justness of our opinion.

In 1820, Dr. Londe, then a member of the Royal Academy of Medicine, having suffered for sometime, great pain, caused by a decayed first large molar of the lower jaw, requested a young physician, one of his friends, to extract it for him. The physician, used the key of Garengeot, and operated in such a manner as to remove with the diseased tooth, the last small molar, with a considerable portion of the alveolus attached—an accident very common when the instrument is used by the inexperienced. The first movement of M. Londe, was to replace the first large molar which was still attached by the gum, and an hour after he returned to its socket the small molar which, till then, had remained lying upon the table. The pain which followed the replacement of these teeth was supportable during the day, but, at night, in consequence of the pressure upon them by the antagonist teeth, caused by an involuntary contraction of the zygomatic temporal and great pterygoidean muscles, it became very intense. M. Duval, whom M. Londe informed of the accident, advised him to keep the jaws slightly separated by a wooden wedge, this afforded relief. The inflammatory swelling of the gums seemed to be entirely dissipated on the eighth day, but the pain continued and M. Londe, guided in theory by his knowledge of physiology, and in practice by the authority of Gariot, who denied the possibility not only of their acquiring a positive adhesion but even a satisfactory degree of firmness, went again to have these teeth extracted, without the interference of M. Du-

* *Nosographie Chirurgicale*, tome ii, page 519.

val, who advised him to retain them in his mouth. The pain indeed diminished and two years after, these teeth seemed to have acquired the greatest degree of firmness.

Here ends the relation of M. Londe,* who declares elsewhere that he was well convinced that these teeth were entirely devoid of vitality; a declaration so much the more important as it was not long before these teeth were lost, contrary to the hopes which were at first excited—this we are authorised to state by this honorable physician. On the same day that this case was presented to the Academy, the celebrated Dupuytren handed in the following note which we copy from the original:

“Five years ago, a young physician, in order to give room to the second teeth, extracted a number of the deciduous teeth of a very young child; amongst the rest he extracted by mistake a permanent, instead of a deciduous tooth. The error, discovered an hour after its occurrence, seemed irreparable. Three hours had elapsed when I saw the child. I directed the tooth to be replaced in its socket; this was done, it was pressed down firmly and kept in place by a bringing together of the two jaws. It has remained in place, since that time without having caused pain or undergone any change in color or alteration of its natural appearance. It answers the same purpose as the rest; it appears to possess an equal degree of vitality, or at least it does not appear to differ from them in any manner.

DUPUYTREN.

May 23, 1820.”

We do not hesitate to say, in spite of this authority, that if M. Delabarre had again seen, six or seven years after the accident, this child, which had given him so favorable opinion of the replacement of teeth in their alveoli, he would have agreed with M. Londe, and would not, contrary to all physiological probabilities, have stated that “the teeth extracted from their sockets and replaced a moment after became perfectly firm, because they contract adhesion, *very intimate and probably vital*, with the surrounding parts”† which, according to his own avowal, did not

* *Voyez le Journal Universal des Sciences Medicales, cahier de juin, 1822.*

† *Traité de la part. Mecaniqu, de l'Art de Chirurgien Dentiste, etc, tome ii, page 322. Voyez Aussi la note qui est au bas de cette page.*

happen in the case in which he attempted the proof in his own person.

In short with regard to the replacement of a tooth which has been removed from its socket, by accident or otherwise, we will say : according to the present state of physiological knowledge, we cannot see that a tooth once removed from its socket and replaced, is anything more than a foreign body perfectly adapted in form to its situation and by that means remaining in juxtaposition. If at the time, when circumstances render necessary the extraction of teeth thus replaced, some appearance of blood-vessels is discovered towards the extremity of the root, or even in the dental canal, it is, in our opinion, no proof that the circulation between the root and bottom of the socket is re-established ; it rather induces us to believe that the alveolo-dental membrane may have granulated, and that some of the granulations may have been thrown into the dental canal. The success which has been obtained by modern surgery, in anto-plastic operations, may, perhaps, furnish ground to some dentists to maintain an opinion opposite to that which we have endeavored to develope and sustain, but which we nevertheless persist in.

However, this may be, when these teeth are replaced and become very loose, some persons, especially when they are in the lower jaw, are in the habit of removing them at night and replacing them in the day-time, keeping them in position by closing the jaws upon them. This is a very bad practice, because the contest which is established between the alveolus, in which there is a tendency to close, and the tooth which acts mechanically in keeping it open, may give rise to a chronic inflammation which is liable to degenerate into a carcinomatous affection. Many cases, and amongst others, one furnished by a venerable ecclesiastic of the environs of Paris, show us that this fear is well grounded.

The diverse considerations and above all, the case of Londe, to which we might add a number exactly similar, proves what we might think of this operation which, under the name of *dental transplantation*, consist in extracting, for a piece of silver, a tooth from the mouth of a young and healthy individual and placing it in the alveolus of the purchaser who had just

lost one of the same kind. A barbarous operation, which we flatter ourselves never to have practiced ; an immoral procedure, which reproves the manners of the day, and the impossibility of finding two teeth whose roots are exactly of the same size, proves the absurdity of attempting it, if its execution does not find a sufficient obstacle in our penal code, which forbids all species of mutilations.

As inhuman and impossible as it is in its final result, the transplantation of a tooth from one mouth to another has, however, for a long time been practiced in France ; it was known here as long ago as the time of Ambrose Paré, who speaks of it thus : "A man worthy of being believed, has affirmed to me that a princess having had a tooth extracted from her own mouth had it replaced with another taken from the mouth of one of her maids ; and which, sometime after, she used as she had done the one she had lost ;" but to prevent being too hasty, he adds ; "I have heard of this case but not seen it." But what is remarkable, is, that it has not been half an age since English surgeons classed it among regular operations, as Benjamin Bell, distinctly asserts, who not only describes it in all its details, but who goes so far as to desire "that he might always have a number of persons ready to furnish their teeth, in order that dentists could always find them of the right size and shape ;" our conferees on the other side have little to envy us, it is true, in this respect, for Maury, declares that he had practiced it upon two persons in 1812.

Finally, we do not terminate that which concerns the injury that some teeth may receive from the fact of the operation having for its end the extraction of the adjoining ones, without speaking of the possibility of removing with a diseased tooth a healthy one, but which might adhere to it, and of the course to pursue in a case where we might foresee the injury before committing it. We have said, that Fauchard related many instances of this kind. See the following case and his reflections upon it : "In 1705, a reverend father recollect of the city of Lude, in Anjou, came to me to have a large molar tooth extracted. I examined his mouth ; I perceived that it was so much decayed that no hold could be obtained upon it. Although I

had seized with the instrument which I used, the tooth he wished me to extract, I nevertheless removed two at once. I believed at the moment that I had committed a great error; but I found that tooth which had followed the first was decayed as much as the other, and that they were so adherent together and united in such a manner by their roots that they formed nearly one body. This, recollect, believing nevertheless that I was deceived, had the curiosity to examine if that which I had said was there. In order to convince ourselves better of the fact, we endeavored in vain to separate the teeth with the blade of a knife: we struck upon the blade with a stone and were only able to separate them by breaking them in pieces."

This case suggested to Fauchard, some very wise reflections which we will report here: He says, "upon this subject, we often meet with difficulties in the extraction of teeth which we cannot anticipate. If there is any way of avoiding the accidents which are liable to occur, it is, with care and without precipitancy. It is necessary to be careful in the first movements which we give to the tooth, and to closely observe the resistance that is made to their first efforts; particularly the effect which it has upon the neighboring teeth. If these latter move, we may infer from thence that the teeth touch in some place. If the movement is very considerable there will be reason to believe that they are united together, and that they adhere to the middle wall or to some other part of the alveolus. In such a case it is necessary to proceed in the manner as we have fully described. When the operator is well instructed, prudent, circumspect and ingenious, he will be able to avoid not only many accidents, but, also, of inventing new methods of procedure, from which the public may derive great advantage."

The cases of teeth adhering together by their roots are so numerous that we often fear the accident here mentioned. It is by conforming strictly to the precautions of Fauchard, that we have many times been able to avoid it. As to the adherence of the teeth by their crowns, of which the examples are more rare, as it does not necessarily imply a union of their roots, we may destroy it with a file, provided we redouble our attention at the moment of the operation and decide correctly

which of the two teeth should be extracted. Five or six years since we separated a large from a small molar, and extracted the first without inflicting any injury upon the second. If the adherence resist at the same time between the crown and the root, the operator, in destroying the first, will certainly have done all which prudence demands of him; that which might follow from the union of the roots could not be imputed to want of skill.

Partial Fractures of the Maxillary Bones.

Fractures which are the accidental results of extraction, are generally confined to the teeth themselves or the alveolar partitions; we have heretofore treated of them. We have, however, seen many cases in which the body of the maxillary bone was broken. Fox gives an example* of this kind, which we have formerly reported of him, that of an individual who, wishing to be freed from an inconvenient and painful wisdom tooth, had a great portion of the inferior jaw removed with the tooth extracted doubtless with an instrument having too large a crotchet. Duval gives similar examples.

We have also in our collection of pieces of pathological anatomy; 1. An enormous sequestrum to which belong the two incisors, the canine and the two small right molars, which we removed from the lower jaw of a person twenty-eight years of age, for whom we had extracted, without the necessary precaution, the first large right molar; 2. A canine, the extraction of which was effected at the expense of the anterior table of the inferior maxillary, more than an inch and two lines in width, and double the length; 3. A first large molar to which adheres all the part of the alveolar border which extends from the second large molar to the canine of the same side, and having the traces of the alveoli of this latter and of the two small molars which had been removed for a long time, with a portion of the maxillary itself, nearly six lines in thickness.

What is very remarkable is, that the teeth implanted in these

* Work quoted, plate 8, figure 8.

two latter pieces are removed and replaced in their alveoli with a facility which shows that the accident was not attributable to malformation of their roots, but the frequency of its occurrence is owing altogether to the awkwardness of the operator. Furthermore, we have had in our possession an enormous portion of the inferior maxillary of the left side, which a negotiator of Paris had the kindness to show to us ; he declared to us that it was the result of the extraction of a molar made with the key, and he had the courage to facilitate its removal by the continual loosening of it to which he submitted.

Among the many deplorable instances of fractures of the lower jaw, which have resulted from the extraction of teeth, we will quote the one, of which Dr. Fournier, of whom we have spoken in another place, has been the subject, which he thus relates, after having spoken of his broken teeth. "Four years before, a dentist of the province, profoundly ignorant of the most elementary principles of his art, being requested to remove for me the opposite tooth of the same jaw, having the same faulty conformation, (exostosis of the root,) he employed vain efforts for more than a minute ; finally, he fractures the alveoli and a part of the jaw, and gave up the operation without having removed the tooth."

Finally, the following fact, related by Maury, furnishes an idea of the disorders that may result from these fractures: "Being in Calais in 1815, we bestowed some care upon a workman who had a portion of the lower jaw fractured in consequence of the extraction of a large molar, which was done with a key having a right shank. The operation had been practised from without *inwardly*, and the surgeon was obliged, by the disposition of the shank of the instrument which he employed, to apply one of the angles of the bolster upon a neighboring tooth ; and in consequence of which the tooth was broken and the jaw fractured. It was nine months after this accident when we were called upon. After examining the patient, whose state even at this period, appeared to us very alarming ; we discovered a considerable fracture of the inferior maxillary bone of the right side, a fracture which had been necessarily produced by the extraction of the tooth. The portion of the bone in

which the other teeth were implanted, from the angle of the jaw to the canine tooth, was necrosed, and in acting as a foreign body, caused mechanical irritation, (he wished doubtless to say : determined mechanically an irritation,) which the presence of several pieces of bone that presented themselves from time to time from the fistulous orifice, considerably increased. A splinter of bone terminating in a point, an inch and three lines in length and eight lines in width, pressing upon the external part of the canine tooth.

Such was the condition of the patient when I proposed to him to have the loose splinters of bone removed. He willingly consented, and after using the precaution to detach from the principal sequestra, a considerable portion which was adherent to it, we proceeded, not without some difficulty, to remove it. The second portion of bone which remained, an inch and nine lines in length, and eight lines in breadth, and occupying as the first, all the right side of the jaw from which the teeth had been extracted, a few days after, with not less success. After this the irritation, and consequently the inflammation ceased ; the parts cicatrised in from fifteen to twenty days ; mastication then became more easy, digestion was re-established, and in less than three weeks the patient was entirely cured. After another voyage to England we had occasion to see him again ; he was scarcely disfigured, although he had lost a large portion of the right side of the maxillary bone, and the canine tooth corresponding to the second large molar of the superior jaw.

When fractures of the alveoli of the superior jaw take place they are generally complicated with fractures of the maxillary sinus, and a laceration of its lining membrane ; the consequence of this is, a discharge of viscid and purulent matter from it. We have only had one case of this description, the subject was a man from thirty to thirty-six years of age, who had had the sinus opened in consequence of an awkward application of the bolster of the key of Garenggeot, employed for the extraction of the second large left molar of the superior jaw.

This tooth, extracted outwardly, with violence, according to the statement of the patient, with the right shank and naked bolster, had drawn with it all the osseous portion forming the

anterior wall of the alveolus which contained it. When the patient presented himself to us, he was still suffering from the accident, and had done nothing since then to prevent the introduction, into the open cavity, of air, alimentary matter, and the mucous fluid of the mouth. He wanted the two small and first large molars. We advised him to have false teeth, mounted upon a base of hippopotamus, with artificial gums, and exactly filling the opening. This piece, fastened behind the third large molar, which was well developed, by means of a large and solid crotchet, (clasp,) and in front to the canine, easily accomplishing the double indication to be fulfilled: to stop up the opening of the sinus, and to fill the space which the absence of the four teeth, and a part of the alveolar border in which they were implanted, had caused.

Highmore, who has given the best description of this cavity, has given to it his name, and left upon record a description of a case of accidental opening, sufficiently curious to render it worthy of being repeated: "A lady having had the superior canine tooth extracted, a portion of the maxillary bone was, at the same time, brought away with it, leaving an opening, from which habitually flowed a serous humor. Wishing to ascertain from whence this humor came, she introduced a stilet, and afterwards a shaved quill, to the width of six fingers, which very much frightened her, believing that she had touched the brain. Highmore assured her, by showing her, in a skull, the cavity in which the quill was introduced, and advised her to bear with patience her affliction."*

Such, also, is the case related by Hoffman, with this difference, however, that the fracture of the sinus had been occasioned by the second large molar, and that he eased his patient by filling this fistule, in order to prevent the introduction of air, and, without doubt, to prevent the escape of the mucus†.

The fractures of the maxillary bones themselves, as the result of the extraction of teeth, are, fortunately, as rare as they are

* *Corpus Humanum, Disquis. ant.*, caput 1, liber 2.

† *De Dentibus, eorum Morbis et Cura*. In 40, *Halæ Magdeburgicæ*, 1711, page 29.

grievous. The course to be pursued in cases of this sort, must necessarily be varied, in proportion to the size of the piece which has been detached. If it is only a splinter of bone, or to specify the case more distinctly, and to particularize the treatment, if but a thin, straight piece, about an inch in length, especially of the lower jaw, it will be necessary, in all cases, to remove it, for this portion, too small to contain the elements of vitality necessary to its reunion to the bone itself, forms not only an obstacle to the nutrition of the teeth near it, and ultimately cause their destruction, but would itself decay, and induce an elementary suppuration, whose resorption would become troublesome, or form fistules, whose aspect would be disagreeable.

"We well know," as M. Lisfranc judiciously observes, in his able treatise on clinical surgery, "that when a bone mortifies in the midst of its living tissue, it is insensibly absorbed, and ends, sometimes, by completely disappearing itself;" but, from the great vitality of the tissue, we may expect a great absorbing energy, from which cannot be expected from the gums, which possess little of this energy; as we think, it is always useful to remove the splinters of the alveoli which result from extraction, especially at the moment when the gums, on being pressed, pass from a bright to a violet red, or when the lightest pressure exerted upon them, puts in action their mobility; for a still greater reason, when we perceive, from slight pressure, that pus is formed between the gums and bone.

The method of removing these fragments of bone, consists in progressively loosening them, by gentle tractions exerted with small forceps, then to completely remove them, when we have reason to believe that their adherence is sufficiently destroyed to prevent a painful laceration of the gum, or a troublesome hæmorrhage. We may prevent inflammation by emollient applications, and assuage the pain by narcotic fomentations, administered in the form of gargles. After the piece has been removed, we should watch the healing of the parts to prevent unnatural adhesions.

If the detached portion is greater than the remaining parts of bone, it is necessary to attempt the union of it with the body of the bone, by keeping it firmly fixed in its place, by means of a

bandage, and only to remove it when it is impossible to accomplish this object.

In fine, as fractures of the maxillary bone, accidentally caused by the extraction of teeth, may necessarily occasion injuries proportioned to the extent of the osseous portion removed, the precautions which we have said should follow a simple fracture of the alveolar border, should be, for a still stronger reason, taken when a portion of the maxillary bone itself is broken.

Complete Fracture of the Inferior Jaw.

We have heretofore treated of fractures of the maxillary bone only in their relation to the extraction of teeth, consequently of those fractures commencing in the alveolar border, and which are common to both jaws. But the body of the inferior maxillary is liable to be fractured completely across; and although this accident, from the fact that it is scarcely ever induced by an operation of our specialty, must needs be strange to us, yet it is no less important to be able to distinguish it, and to know with exactness the principles upon which to base its treatment. In effect, as it is nearly always the result of causes whose action is extended to the teeth as well as the jaw, the intervention of the dentist is necessarily called for, and it would be ridiculous if he were not able, at the same time, to remedy the injury the teeth sustain, and also the bone in which they are implanted; we think ourselves, then, obligated here to treat of it as briefly as possible.

1st. The compactness of the inferior maxillary, the great mobility and elasticity which its parabolical form necessarily gives to it, will explain why entire fractures are so rare. This fracture, ordinarily occasioned by blows or falls, offers, as it regards its seat, important differences; sometimes it attacks the body of the bone itself, and then it has a seat in the symphysis, or from this symphysis to the masseter, that is to say, even to the union of the branches to the body; sometimes, on the contrary, it attacks the branches, the condyles, the coronoid apophysis or the alveolar border. As most other fractures, it may be either vertical, transversal, oblique, simple, complicated, comminutive,

single or double. Finally, it may exist at the same time upon both sides, especially when it affects the body of the bone or its condyles.

The causes which occasion this fracture act in two different manners ;* in the first case, violence tends to destroy the curve described by the bone, the solution of continuity will commence with the osseous fibres of the lingual face ; the instances of fractures produced by this mechanism are not rare. In the second case, it results from a double pressure exerted upon the two sides of the line, and increasing its curvature ; this fracture, ordinarily simple, will commence with the fibres of the convexity, or external fibres of the line.

The characteristics of this fracture are very easily determined. "A blow, a fall," says Boyer,† "a difficulty of the movement of the part in pronunciation and mastication, and more or less acute pains, are some of the circumstances which cause it to be suspected. But if, in placing the fingers along the inferior border of the line, we find some points, either on one side, or all the part, which are not on the circle with the rest ; or if, on examining the teeth, we perceive between them the same relation that we observe between the different points of its base, we cannot doubt the existence of this fracture.

"When it is double, and comprehends all the anterior part of the jaw, the displacement and deformity are so considerable that the slightest glance would observe it. We cannot detect the fracture except by crepitation ; we then endeavor to make the extremities of the fractured bone move one upon another, by seizing the two parts of the jaw, and moving them in contrary directions. The fracture of the neck of the condyle being always accompanied by displacement, it is not difficult to detect the fracture, at least when it is accompanied by considerable swelling of the soft parts."

Let us add, that when the fracture is oblique, from above downwards, and from before backwards, the displacement is very easy ; it is on the contrary, when the obliquity is in an

* VIDAL, (de Cassis,) page 72.

† Treatise upon Surgical Diseases, vol. 5, p. 127.

opposite direction, because the contraction of the masseter presses the inferior fragments against the superior, and thus renders displacement almost impossible. There is no displacement when the fracture presses against one of the branches of the bone, because the masseter muscle and the internal pterygoidean hold the fragments in their proper position. It is the mobility and crepitation which reveals their existence. We obtain these signs by taking hold of the branch of the bone within the mouth, and its angle without, and producing these movements. Finally, in all cases where displacement is well established, it may nearly always be perceived by examining the dental arch.

2. Fractures of the inferior jaw, whether they are simple or compound, are easy to reduce. In order to do it, we place the displaced part in height, and a little before, and upon the base of the bone, in such a manner as to bring it back again upon a level with the portion which remains in its natural position. It is only by giving attention to the line which should form the base of the jaw, and observing if the dental arch is in its natural state, that we can assure ourselves whether the reduction is well made. But it is difficult to maintain the reduced fracture; we cannot accomplish it without sustaining the inferior jaw against the superior.

"The means which have been proposed for accomplishing this important indication," says Sauson,* "are as numerous as those which corresponds to the difficulty of effecting it. They vary according as the fracture affects the body or other parts of the maxillary bone, and as it is or is not accompanied by the displacement of the fractured pieces. For fractures of the body of the bone, without displacement, some surgeons employ a method proposed by Hippocrates, and which consists in tying together, with a thread of metal, the adjoining teeth of the fractured extremities; we then bring the jaws together by means of a bandage, called *the sling of the chin*.

But if the tendency to displacement is considerable, and in

* *Dictionary of Medicine and Practical Surgery*, vol. viii, page 473, article *Fractures*.

the case of compound or oblique fractures, we are obliged to have recourse to more efficient means. We have rejected the leather and pasteboard splints of which Ambrose Paré, Duverney and Hunter envelope the base of the jaw, as well as the woollen cylinder, which Bottcher thrust within, from the base of the jaw, in order to form a sort of internal support, whilst the fragments were sustained by means of a pasteboard bandage applied upon the external face of the bone. Boyer employed two gages of hollow cork, upon their two faces, with gutters destined to receive the dental arch, leaving between them, in front, a space for the introduction of drinks, with the end of a spoon, and for the flowing of the saliva.

In England a splint of pasteboard is employed, the description of which is given by Samuel Cooper:* "As soon as the fracture is reduced, the surgeon should adapt upon the base and length of the lateral parts of the inferior jaw of the patient, a thick pasteboard, previously softened and moistened with vinegar; we should apply, below, a bandage of four divisions, of which the centre should be placed upon the chin, the two posterior ones fixed upon the anterior part of his cap, and the two anterior ones fixed to the same, but farther back. When the pasteboard is dry, it forms the most commodious apparel that we can imagine for surrounding and sustaining the fracture. We then apply a plaster of soap upon the skin, to prevent the inconvenience which might result from the pressure exerted by the pasteboard, and its hardness."

The different methods, as we see, act only by drawing the two jaws together; but many practitioners have thought that it might be advantageous to render the apparel of the inferior jaw independent of the support of the superior. In order to accomplish this, Dr. Jousset† has constructed, 1st. A splint of tin submentonniere, which entirely embraces the fragments, and is fixed to the neck; 2d. A gutter of the same metal, which is adapted to the crowns of the inferior teeth, and embraces its fragments; 3d. A stem of tin, which is soldered to the two pre-

* *Dictionary of Surgery*, vol. 1, p. 184.

† *Medical Gazette*, year 1833, p. 222.

ceding pieces, and passes before the jaw. This third piece is sometimes only soldered on one side, and fixed to the other by a screw. By this arrangement, the fragments are enclosed as in a box, and the patient can at pleasure move the jaws, speak and eat, without deranging the fragments.

Dr. Baudens, now head surgeon in the military hospital of the Val-de-Grace, has thought that the end proposed by the last practitioner quoted, might be better arrived at, by maintaining the fragments reunited, by means of a band passing from the interior to the exterior of the mouth, and drawing the base of the jaw within from the skin, in order to tie it upon the dental arch. This method would only be suitable for oblique fractures of the bone; but in every case it would be so painful and frightful for the patient, who, notwithstanding the success obtained upon a soldier, who fractured his jaw by falling from a horse, and who presented himself to the Royal Academy of Medicine, was there about two years before he had courage to apply to the surgeons without the hospital. We think that the apparel of Boyer or of Samuel Cooper are preferable to that of Jousset, which might be very painful.

Although our researches have not conducted us to the discovery of a single instance of complete fracture of the inferior jaw, such as we have described, in consequence of the extraction of teeth, we do no less advise young practitioners to proceed with much prudence, upon subjects affected with scrofulous and syphilitic diseases. In these two affections, as we know, the bone acquires, sometimes, such a fragility, that the slightest violence would break the inferior maxillary. We met with, some years since, a person bearing evident traces of the first of these two affections, so much so, that we feared this accident in extracting one of the first large molars, which she had requested us to do. We proceeded with the greatest care, and the tooth experienced scarcely any lateral movement; we succeeded well, but, two or three months after, we learned that this person had, in consequence of a slight fall, fractured the jaw, at the union of the anterior third of its body with the two posterior thirds.

Luxation of the Inferior Jaw.

This injury evidently belongs as complete fracture, in the department of general surgery, since it has nothing in common, neither with the teeth, nor with the osseous border upon which they are implanted ; but as it may be the result of an operation belonging essentially to our specialty, which might cause an extraordinary opening of the mouth, we judge it indispensable to treat of it here, in order that the dentist, may not be obliged to have recourse to the knowledge of a professional brother in order to repair an injury which he had himself occasioned, as it has happened to Fox, who did not fear to acknowledge it, and as it might many times have happened in the course of our career, if we had not been always ready to face it.

1st. To give an exact account of this luxation, it seems to us it will not be sufficient to know, as elementary authors very briefly say, that the inferior jaw forms, in the act of mastication, by turns, a lever of the third or fourth kind, as the next to that body to be broken finds itself placed upon the anterior teeth or within the depths of the mouth, that is to say ; before or behind the masseter muscle—the principle power in virtue of which this act is performed ; it will be particularly necessary to understand perfectly what takes place in the falling of the jaw. We see then, that the muscles, by which this last act is effected, although they serve principally to conquer the resistance of the elevators, tends in the mean time, always, to curve the angular form of the lever, and carry the condyle or articulating extremity of bone, which, pressing violently upon the anterior face of its capsule, rends it, and glides in front of the glenoid cavity.

There is no lever then of the second kind, whose resistance, represented by the masseter, was placed between the depressions and the articulation, but a transformation of this lever into one of the first kind, in which the inferior extremity of the elongated masseter becomes the centre of movement, that is to say, the point around which the jaw tends to pivot, and the head of the bone the resistance which, vanquished, rapidly carries itself forward. The departure of the head of this from the cavity, the

fibres of the masseter, becoming parallel to the body of the bone in which they are inserted, are necessarily more needed for maintaining them before than for carrying them back behind. This luxation, as we have already said, is very difficult, not to say completely impossible, in early infancy, because the branches of the jaw, at this age, are nearly parallel to the body of the bone, from whence results its downward movements, passing around an axletree which traverses the condyles themselves ; it is also necessary that this falling should draw the bone in a vertical direction, that its articular extremities may depart from the cavity. The only example of which we have heard of this kind, is related by Sir Astley Cooper : "I have seen" says he, "a case in which two children disputing for an apple, one of them forced it into his mouth and luxated the jaw."

At the moment when the luxation of the jaw is affected, a sharp pain is felt in the luxated articulations. The jaw remains immovably depressed and it is impossible to make it meet the superior ; articulation is impossible or very much embarrassed ; the projection formed in this natural state behind and below the ear, is replaced by a depression sensible to the touch. Finally, the movements of the muscles of the jaw, produce a marked flattening in that part of the face and in the region of the temple.

2. An absolute ignorance or a false appreciation of the mechanism by which this accident is caused, has a long time led to the adoption of defective means for remedying it. Success has been promptly and easily attained only when one has ceased to carry upon the chin the principal effort necessary to its reduction, and when we have perceived that the first indication to be fulfilled, was to conquer the resistances offered by the elongated muscles, and to depress the condyles, in order to liberate them, then to carry them backwards to the cavities which they had abandoned.

This triple indication which, for the good of man, seems to be a conquest of modern surgery, had, however, been established by Fabrice d'Aquapendente, as would seem from these quotations : "It is necessary," said this author, "to make the movement contrary to that which it made when it left its cavity."

The jaw leaves it behind ; it is drawn down, it is necessary therefore to elevate the jaw. 3. The muscles drawn from above the sharp apophysis ; it is necessary then to bring it back. If it is luxated only from one of its articular cavities, it is necessary to proceed by a strong movement : if both cavities have been left the first thing the surgeon should do, is to pull it forward, then depress it, then push it backwards and lastly upwards."

These various indications are sometimes filled by wedges of wood and sometimes by levers placed between the molar teeth, and upon which pressure is made whilst another person draws from below upward with a bandage under the chin. This is the procedure advised by Fox, and a French dentist Dubois Chemant, of whom we shall have occasion to speak in our dental prosthesis.

But the following method which is now adopted as a principle of modern surgery, is altogether more rational and simple : it consists in applying and securely maintaining the head of the patient upon the breast of an assistant, and to place the two thumbs, wrapped with linen, as far back between the teeth as possible, and to embrace the whole body of the maxillary bone with the other fingers bent under the chin ; then to press firmly upon the inferior dental arch with the thumbs, in such a manner as immediately to completely depress the whole of the bone ; and when we begin to move the condyles, we at the same time push them backwards, whilst with the fingers placed under the chin we relieve this part. The contraction of the muscles of the luxated bone brings the heads of it in place, but sometimes so quickly that the fingers of the operator might be bitten if he did not turn his thumbs, or if he had not had the presence of mind, to place between the jaws in front of his thumbs a stopper of cork or some other substance capable of annulling the efforts of the shock.

In a case of this luxation in an unruly gesture, Sir Astley Cooper, has taken the following course : He says, "I placed him upon a table in a dorsal decubitus, with a supporter upon a cushion ; he was held in this position by several persons, then placing myself behind his head, I introduced between the molar teeth on each side the handle of a table fork, using the

precaution to wrap the teeth in a handkerchief, and while it was held in this position, I firmly drew the lower jaw towards the upper; the reduction was made with ease and promptly.”*

Therefore, then, that which we have said of the jaw, considered as a lever of the first kind at the moment of luxation, is found confirmed in all points, by the means employed for reducing this luxation. It is always a lever of the first kind, which we endeavor to make a see-saw of. The power is in the palm of the hand of the operator, the thumb which presses forcibly upon the middle of the body of the jaw is the fulcrum; the resistance the condyle which we attempt to carry forward. The masseter muscle also offers a resistance to be overcome, but, it is only secondary; and it is necessary to use precaution, to prevent the fingers from being bitten at the moment when this muscle becomes the power, and this is only at the instance where the condyles glide into their cavities.†

CHAPTER II.

PROSTHESIS OR MECHANICAL DENTISTRY.

The part of our profession, which, under the name of prosthesis, consists in substituting false teeth for those which have been accidentally lost, or whose sacrifice has been judged necessary, in remedying certain loss of substance either of alveolar border, or of the palatine vault, constitutes neither a new art, nor one extensively cultivated by people advanced in civilization. If, in effect, on the one hand, we find in the writings of Latin or Greek authors, historians or poets, proofs which evidently attest that the civilized people of antiquity not only knew the care the teeth required for their preservation, but, still more, they knew how to supply their loss by mechanical procedures, we

* Work quoted, page 126.—Let us remark that the handles of forks which the people of England use, are not like ours, metallic and flattened, but of wood, or bone, and as thick as those of our table knives.

† Excellent advice is given upon this luxation in the inaugural thesis, of Capuron, given in the year 9.

perceive, also, on the other hand, from the accounts of travellers, that this art is wholly unknown to the people who inhabit certain parts of the ancient or new world.

We have in favor of the first of these two assertions, the amendment to the eleventh article of the law of the XII Tables, borrowed by the decemvirs of Rome from the Grecian legislature, and which permitted the bodies to be burned with the gold attached to their teeth: amendment which certainly applies to artificial teeth, whose removal was regarded as profanation, and not only, as Duval seems to believe, to the loose or fractured teeth, that he had had an idea of adjusting with bands.* In favor of the second assertion, we find in Bontius,† that the inhabitants of the island of Java and of some other countries of India, who lose their teeth at youth replace them by others of gold. Genelli Carreri says the same.‡

But, whatever may be the origin of dental prosthesis, the sole spirit of civilization, or the result of necessity, we have reason to believe that it never had arrived to a degree of perfection until the *present day*, and we can say, without fear of contradiction that *France*, with just reason, prides herself in being the country in which the greatest progress has been made with its advantages, and the most capable of extending its use. The moment is not far distant, doubtless, when each one of us, better enlightened upon the causes of diseases of the teeth, that is to say, being convinced that these diseases may result from other causes than negligence or the progress of age, and led, besides, by the integrity of the dentists, of our day, which renders their services accessible to all, will be able with care and with as little mystery as any other imperfection can, to repair the losses that these diseases so frequently cause.

* See upon this subject the different commentaries upon the law of the XII Tables, by F. Holtman, page 55; and Bouchard, page 558, etc.—See also, Martial, book v. epi. gram. 43, which contains these two verses:

Thais habet nigris, niveos Lecarria devtes:

Quee ratio est? emptos hae habet, illa suos.

Thais has black teeth, Lecarria has them as white as snow,
What is the reason of this? the one has her teeth, the other bought them.

Edit. of Latin Classics of Nisard.

† *De Medicinê Idderum.*

‡ *Voyage around the world*, vol. v, page 128.

"There is, however, one thing which should astonish persons who are struck with the importance of dental prosthesis and who in acknowledging the tendency that all classes of society have to profit by the advantages that it offers, are ready to admire the perfection that it has acquired in our day ; that is the small number of works to which it has given birth. What has been published in effect upon this subject, since Fauchard, occupying a just place, for prosthesis as for pathology, in the first rank amongst those who in our profession had had the laudible ambition to trace the rules to establish principles, and, consequently to furnish models? Two or three works only have merited serious attention, that of Delabarre,* production which proves a perfect knowledge of the subject, a great habit of judging, and extreme skill in doing, but who, unfortunately, was possessed of a mind scarcely methodical enough to be always well understood, and whose desire of being odd, often led him from the precision of facts, and often beyond possible things. This work also lost its value, by its want of order and the absence of general principles, plainly expressed ideas, and by its being filled with a multiplicity of details which were only useful to those who already were informed.

From wherever comes this scarcity of works, but particularly of elementary ones, upon a subject which is daily becoming more appreciated, for the importance of the laws of hygiene, is constantly experienced, and while so many proofs, particularly in large cities, convince us that their practical observance is so superior?† from this fact, most dentists in making the mechanical part of our art, the principal object of the profession, that which furnishes the most proof of their skill, and from which

* Work quoted.—M. J. Audibran has also published in 1821, a *Treatise upon Incorruptible Artificial Teeth*; but treating only of mineral teeth, he has directed all that which he has said of it in the generalities, which makes it to be regretted that he has not reduced it to few pages.

† The English dentists have long since given us justice in this respect, for we find in a work published at London, in 1823, by Gerbaux, under the title of : *A Practical Treatise upon the most frequent Diseases of the Mouth and Teeth, and especially the accidents of the first dentition*, this phrase : It is in Paris principally that the best works upon this interesting subject have been published.

they desire the most clear advantage, they receive by transmitting publicly the fruit of their experience to their professional brethren; in this respect, they will be supposed more adroit than wise, by passing, in a word, rather for artists than physicians.

It is not rare even at the present day to meet with dentists, besides being very honorable and of high standing, (sociably speaking,) having a contempt for mechanical dentistry; so much so as to regard the extraction and the plugging of teeth as the only operations that they can practice without derogating themselves, and having the good nature to believe themselves more useful to society by discoursing upon the incisors of the castor or the canines of the elephant, then by giving to the disgarnished human jaw the means of performing all the functions that nature had primitively given to it. Strange pretension, which has engendered these views; happily so few a number, of mixed practitioners who, under the name of *medico-dentists*, are not appreciated by the *medico-surgeon*, properly speaking, but by their true worth, and are with difficulty understood by the public, whose good sense often leads them to believe that the man of the art who embraces a speciality ought at least exercise it entirely.

Our advice, is then, that, since dental prosthesis acquires every day a greater importance, since it furnishes at least half of the cases upon which we are consulted, it should be studied and practiced with the same care as the other parts of our profession. This question naturally presents itself here: should the surgeon dentists, as *Laforge* wishes, always manufacture all the pieces of artificial denture; or should he conform to *Gariot's* advice, be contented with taking the impression of his pieces and trust the fabrication of them to his workmen?

If it were necessary to reply to this question in a single word, and to adopt one of these two opinions to the detriment of the other, we would not hesitate to pronounce formally in favor of *Laforge's*, for a very long experience has demonstrated to us that those who depend exclusively upon their workmen to construct their artificial pieces, are always obliged to retouch the work, because whatever care we may take in procuring a model of the place of a natural tooth, whatever precaution we use to secure

a correct form to the piece, and that style of art, which we call the expression of the physiognomy, if we may be permitted so to speak, which the artificial piece destined to occupy the place of the natural tooth should take, it is impossible to convey to another, and especially the true disposition of the mouth. Those who do this work, know very well the difficulty in giving the numerous details necessary for a simple piece, much more so, for a complicated piece, how then can a workman, however adroit and deserving he may be, form a just idea of that which he undertakes without having an opportunity of judging for himself the particular character which each piece should have, a character which the eye can more correctly comprehend, than can be obtained from any description?

However just may be this opinion as a whole, it is not necessary however to deduce from it consequences which should make it too rigorously the duty of the dentist, to do *all*, and *all* alone, of those multitude of objects which pertain to dental prosthesis. For who wishes in effect to give an exact account of the fabrication and the slowness of adjustment of some one of their objects? it is evident that, although varied but little as is the labor of the dentist, he could not accomplish all of this labor alone; he would be obliged to be interrupted to attend to other duties not less inperious.

It is necessary, then, in order to avoid all exaggeration, which at a later period would be perceived by the student, after he had become a practitioner, as untrue, to admit in principle that it does not suffice for the man who wishes to exercise in a proper manner his profession and to avoid the many shoals in the practice of prosthesis, to know how to take impressions and to make moulds, to know the physical laws which govern the attachment of pieces, to know how to mould, to saw, to file, to bore, solder metals, to precipitate, and to know all the material and all the manners of work of which they are susceptible, but it is necessary still more that he should, in the course of his studies, fabricate himself and all *alone* all the artificial pieces. Certain then of being able to direct, because he knows how to do it himself, a mechanical workman might be made useful to him. These workmen are ordinarily jewellers, more accustom-

ed than any body else to handling delicate and precious objects. He could direct them to prepare pieces, to solder them in the right place, and to fabricate all the parts which form it, he could stop the procedure of the work at any time upon the model, to try it upon the patient, and in order to make a proper assistant take the most advantageous part from the workmen he employs, for the purpose of economising time, material and the adjustment of pieces ; the dentist who cannot fabricate, himself, should always have a workman at hand ; finally, he should be able to survey the work, and communicate promptly all his intentions, and instruct him in all the details necessary for each piece.

"I think," says, with reason, a modern author, "that a dentist should be in his cabinet, during the construction of artificial pieces, as a statuary in his shop, who conceives and designs his subjects, by tracing all the divisions upon the marble and trusting only the purely mechanical part to the workmen whom he has constantly under his eye and whose hands he can direct, so to speak, so that he can, in the last place, give all the grace and finish to it, in order to render it a true object of art. It is this absolute necessity of knowledge in medicine and mechanics which has made at all times and will always make of our profession a specialty perfectly distinct from all the other healing branches. But, for a pitiful compensation, there are those who unfortunately facilitate the access to it, to a crowd of ignorant folks who believe they have overcome every obstacle when they have mounted some teeth upon plates or roots, destined to receive them."

We regret that this necessity of equal knowledge in mechanics and medicine should not be also admitted by English dentists, as it is with us, and most French practitioners, as the following phrase, extracted from an English author whom we have quoted, proves : "I admit that the prodigious extent of knowledge that the art of the dentist demands can rarely be in the possession of one individual. I think that it would be advantageous to its progress if the mechanical part was executed only by artists who make it their profession." In abandoning such an opinion, they may expect, without doubt, that superiority which we meet with in many of them.

From these general considerations, which show the opinion that we entertain and what utility we would naturally make of dental prosthesis, and the manner its study should be considered by the dentist, let us pass to the methods of execution, by confining ourselves to general views, that is to say, by omitting all minute details of fabrication which belong more to the jeweller's art than to the dentist's, and which, we have already said, are of no use to the student who does not frequent the work shop, since he could not comprehend them, and would be completely useless, superfluous even for those who have practised, since it would only be a repetition of that which they already know.

Of substances employed for the construction of Pieces of Artificial Teeth.

Different in this respect from most authors who have written upon our art, and who give the name of *pieces* to the re-union of many artificial teeth, we employ this word only to designate every object which belongs to the replacement of any portion whatsoever of a denture. If it is only composed of one tooth we call it a *simple* piece, if it is of many, we call it a *complicated* piece; if it is, in fine, of as many teeth as the jaws naturally have, it is then a *complete* piece, if we like a *denture* or a *ratelier*.

It has been, doubtless, in the construction of these pieces as in all objects which are classed by their nature among the arts: before seeking the necessary and agreeable, we have necessarily been occupied with the simple and the useful. As the first substance susceptible of being cut in the form of coin was sufficiently hard to resist the pressure of the aliments in mastication, and was white enough to approach the color of the teeth, that was first used to replace them.

But in proportion as civilization, by its progress, caused luxury to be desired, we became necessarily more exacting; we not only contended for that which was useful, but we desired to add to solidity of force, beauty, and all the other advantages inherent to the natural teeth themselves. With this design we then successively used the bone and teeth of the calf, those of

the horse, the teeth of the sheep, of the stag, and many other animals, the ivory or tusks of the elephant, the teeth of the hippopotamus, of the whale, of the morse, human teeth, and finally teeth made of mineral paste.

Of these different substances, the only ones which are generally employed at the present day, are the *teeth of the hippopotamus or sea-horse, human teeth and those of mineral paste*; these are consequently, the only ones of which we shall treat.

Ivory, which has been employed a long time, and whose antiquity is incontestable, as Martial,* who we have already quoted, speaks of it in formal terms, is nearly completely abandoned, for two reasons: first, whatever may be the age of the animal which furnishes it, it is not of a texture sufficiently resisting for the action of the saliva and the buccal mucus, but decomposes and soon is destroyed. This slow decomposition necessarily gives the breath an unpleasant odor; which is particularly the case with the teeth of the *morse*, vulgarly called the *sea-cow*, or those of the whale, which we find sometimes mingled with those of the sea-horse, and which is not much used, excepting for bases, for want of harder substances. The second reason which causes us to reject the ivory is, that it is ordinarily marked with small whitish spots which give to it a greenish color not suitable for imitating the texture of the teeth.

The bone of the beef, of the horse, and of the stag, *which are deprived of enamel*, and very porous, imitate but very imperfectly the natural teeth, and soon turn yellow, however cleaned and whitened they may be kept. But, the extreme hardness of some of their parts, their low price, and above all the difficulty experienced, under some circumstances, in procuring others, has induced some dentists to employ them as bases. Finally, the teeth of these same animals, properly cut, have sometimes been employed; but then it is important that they should be procured from old animals, because their tissue is more resisting and their canals entirely or in a great measure effaced.

* Sic dentata sibi videtur Ægle
Emptis ossibus, indicoque cernu.

Teeth of the Hippopotamus.

The hippopotamus or *sea-horse*,* placed by Buffon in the class of mammiferous animals, in the order of pachydermata,† is, as we know, a shapeless and monstrous animal which is between the sizes of the elephant and rhinoceros. They inhabit the banks of large rivers, particularly those of Africa, as the *Nile*, the *Senegal* or *Niger*, the *Gambria*, the *Zaire*, in the midst of which they pass a part of their lives. They are no where so common as at *Cape Mesurado*.‡ The most remarkable thing about these animals is, that their teeth are serrated more than those of the elephant, and the whiteness of which is preserved for a much longer time without changing, a quality which ivory does not possess it, changes quickly when old; they are, therefore, more frequently used in dental prosthesis. Their employment is much more ancient than is generally believed, Fauchard expresses himself thus with regard to them: "The human teeth and those of the sea-horse are preferable to every other material, because they have their enamel and more strongly resist the action of bodies which come in contact with them."

Lefoulon then commits an error in saying, "*that he had had, for a long time, an idea of substituting them for ivory.*" Let this be as it may, of the *forty-four teeth* with which the jaws of this animal are furnished, we use only the canines, which are the tusks, and the incisors.

The canines are necessarily the largest and longest, especially in the inferior jaw. They generally weigh two or three pounds; but we have known some of them to weigh six or eight. Bent

* Delabarre thinks we have done wrong in giving the name of sea-horse to the hippopotamus. All naturalists call the animal under one or the other of these two names. The etymology of the two words proves the resemblance which we believe, exists between the one and the other. The inhabitants of that part of Egypt where it is found, named it the *foras elbar*, which signifies a *sea-horse*.

† See *Complete Works*, vol. 4. (edit. of 1837.)

‡ *Voyage of Desmaris*, vol. 2, page 148. See also Kolbe, description of the Cape of Good Hope, vol. iii, chap. 3, and Adison's voyage to Senegal, Paris, 1757, page 75; &c. &c.

as the tusks of our wild boar, they have one of their faces flat, and the other convex. Slightly facing in regard to their length towards their plane part, they are only enamelled upon their external or convex side, which fact prevents us from employing them for the same purposes as the incisors; but their superiority in size renders them fit, even when broken in pieces, to be employed for the construction either of complete dentures, or for bases upon which we may fasten enamelled pieces, whether human or mineral teeth. These are those which we commonly call the teeth of the sea-horse. As, in many circumstances, the enamel with which they are furnished may injure the work for which we wish to submit them, we can deprive them of it either by breaking it in scales with the scissors and hammer, or by using the grindstone, or even by acids. When we employ this last method we should be careful to prevent the acid from corroding the parts not enamelled; in order to prevent this, we should place upon these parts either tallow or soft wax.

The incisors are short, half cylindrical in front, but deeply indented behind. The upper ones are covered with a very thick enamel, which closely resembles that which covers the human teeth; the curve which they describe before permits them to be cut in four, six and sometimes even in eight perfectly enamelled teeth, whose disposition corresponds exactly to the form of the alveolar arches. Those in the lower jaw are less sought, because they are without enamel: they are improperly called the teeth of the *sea-cow*. They are rounded and sometimes are of sufficient size to be used for dentures in a single piece; they are often confounded with those of the morse, which is the true sea-cow, another great amphibious animal, which, by its habits, and especially by its conformation, approaches infinitely nearer to the whale kind than to quadrupeds.

As we often find in commerce the teeth of the morse and even of the whale mixed with those of the hippopotamus, we should recollect that the first differ essentially from the second, first, because they are less rounded and nearly straight, instead of being curved and half cylindrical as the canines or tusks of the hippopotamus, or hollow behind as its incisors; secondly, because they are simply covered with a kind of yellow and white

shell instead of being provided with enamel: besides they have not as much hardness as ivory; the saliva then quickly effects them.

The canine or incisor teeth of the hippopotamus are far from presenting the same appearance, and from being of the same quality. We find in trade some large, middling, small, old, white, brown, gray, even marbled, half round, flat and sided ones; but all of them, when we cut them cross-ways, present a furrow more or less marked, which, under the form of a curved line, cuts their great diameter. As this line is formed of material more tender than the rest of the tooth, and consequently as it is more quickly changed by the fluids of the mouth, it should be entirely removed when a denture is to be made from it, this can always be done when the tooth is of sufficient size.

In general, the teeth of the hippopotamus, from which we intend to form enamelled pieces, should be white exteriorly, without deep furrows or clefts. Those which are brown have no enamel, but can, nevertheless, be used. But whatever may be the beauty of the substance, and whatever piece we may choose, its excessive whiteness renders it unsuitable for use, without previous preparation, particularly when it is first used; it, unfortunately, soon loses this brilliancy, only to take a yellowish or bluish tint, which never leaves it. Thus, dentists who wish to put up very neat pieces, use it only for bases or supports, upon which they attach natural or mineral teeth.

When it is used only for this purpose, the fibres should not have a vertical but a horizontal direction, because it will secure to it a much greater power of resistance.

As it regards the method of giving to the hippopotamus or any other substance of similar texture, the form of the teeth and gums, it constitutes an art similar to that of the manufacturing of chessmen and dice, and to that of sculpturing. It is not sufficient, at the present day, as in the times of Fauchard, in order to imitate teeth, to establish separations on the anterior part of a piece of hippopotamus, nor either to reduce the extremity of each piece to a point, or by filing it crossways, according as we wish to represent an incisor, canine or molar; but it is necessary that the piece should represent, as nearly as possible, the teeth

whose place it is to occupy, so that it will not be detected as artificial.

It is necessary that we should divide the hippopotamus in pieces of convenient size with a saw. The piece to be used once selected, the dimensions of the piece should be described with a compass, and the details traced with a crayon, and the form imprinted with a rasp or file ; but the engraver, scraper and burin, employed in the same manner as in engraving and sculpturing, can only aid us sometimes, however, by the grindstone and drill moved in a lathe, serve to complete the work, and give it a convenient finish. We next polish it, colored or not, with a small quantity of very finely powdered stone, on a piece of soft wood or linen, or by some other means. Without wishing to describe in detail the different methods of working hippopotamus, methods which must necessarily vary according to the piece we wish to construct ; we will, however, examine each fundamental preparation through which it must pass before it is ready to be placed in the mouth.

We have said that we divide the hippopotamus into convenient pieces with the saw ; but this instrument will have to be as well serrated and tempered as if it had to be used on a piece of iron or brass, because the enamel of this substance is so hard that saws of ordinary tempering would soon be dulled, bent or worn out, without advancing into the substance of the tooth. It would also be prudent to cut through the enamel, with a triangular file, before using the saw. In order to do this, the tooth of the hippopotamus should be placed in a vice, enveloped, however, in a piece of cloth or skin, so that the tooth, being firmly seized, will not slip through the jaws of the instrument, at the same time, so that the enamel should not be cut excepting in the points seized ; we then make a groove with the file, around the tooth, upon the parts where we wish the saw to act.

As the saw cannot proceed very far into the substance of the hippopotamus, no more than it could in the ivory, without heating and without softening it by its own caloric, we should stop occasionally, in order to allow it to cool, at least we should watch it, in order to prevent it from softening. When the pieces are so divided, we should preserve them perfect, in order to

make the piece destined to represent the teeth and their base of the same piece, leaving the enamel for the first, and calcining it by the flame of the lamp, whilst we use the grindstone for the latter. But even if we wish to saw them for isolated teeth, we cut them in as many pieces as we wish to make, always giving the preference to those which are covered with the most regular enamel. In this latter case, we may avoid the brilliancy of that enamel upon its edges, by commencing to file it in these places ; if we desire it, we can effect this by means of a drill.

When the hippopotamus is cut for the purpose for which we wish to employ it, the several parts of the piece are then worked in detail. In order to do this, ancient dentists placed it in the same vice employed for its first division ; but we are daily convinced it is better to hold it in the hand whilst we are working it and apply it upon the trennel of the work table. Some dentists fasten it there by means of a double cord passed through a hole pierced in the trennel of the table and which is confined to a treadle upon the ground. When they wish to fix a piece firmly between the trennel and the cord, they fasten it in the handle which forms this, and move it with the foot placed on the treadle. Thus maintained, the piece cannot escape the instruments employed in working it, and it is not liable to be damaged by the jaws or serres of the vice, if we cover these last with cloth, skin, or cork ; but this method would not be appropriate for working it in the hand.

When we wish to construct a base, we take a piece not enamelled, and whose fibres run horizontally ; we cut with an *engraver's tool*, or with a lathe drill to the model of which we shall soon speak. We then form a base which encases the alveolar border upon which it fits in such a manner as to subserve the purpose for which it is to be used. We then draw with a pencil, but only in front, a curve similar to the one described by the gums, then, either with a *gouge*, or with a *rasp*, or with a drill, we scollop or curve each arch, commencing with the primitively fixed median line.

If we, on the contrary, wish to make a simple tooth, an incisor for example, the piece of hippopotamus furnished with its enamel being properly arranged, we hollow it to the part upon

which it is to rest, either upon the osseous or metallic bone to which it should be united ; this is accomplished with the half round file, or that which we call the rat-tail file, sometimes also with the engraver. Then, in order to hollow the posterior part, we saw the piece obliquely from the bone to the summit ; but when we have passed through about two-thirds of its thickness, we stop to give a vertical stroke to the saw which shall meet the first incision ; but this would be better accomplished with a half round file. We should next commence with the various details of its form.

We will observe in this respect that if we wish absolutely to make, from the hippopotamus, teeth furnished with enamel upon their anterior and lateral faces, we may accomplish it by cutting the hippopotamus upon certain of its projections which appear on it. This method of procedure occasions a great loss of the material. It may, however, satisfy those who refuse, for reasons either good or bad, to make use of human or mineral teeth. We have made many complete pieces and even complete sets of teeth in this manner.

Finally, to manufacture a complete denture with the teeth and their base, sculptured from a single piece is decidedly the most difficult piece of dental mechanism that can be made from the hippopotamus, for it not only possesses difficulties inherent to the teeth and to their basis, but still more, these which are the result of the union of the two parts. In order that a piece of this nature may be well made, the dentist should trace from the mouth of the person for whom it is destined the medium vertical line which should serve him for regulating the division of the teeth. He should then draw these last with the crayon, taking care to leave for each of them the proper size.

Thus the central or great incisors should be broad and flat, particularly those of the upper jaw, which are about a quarter larger than those of the lower jaw ; the lateral or smaller incisors, should be a third narrower ; the canines more or less rounded, elongated or pointed, according to the person, should be nearly as wide as the lateral incisors. The small molars should be a fifth smaller than the canines, and the large ones should have a volume equal to the two small ones. In order to hollow the

tritulating face of the large and small molars, some dentists employ a sharp drill; we prefer the engraver, which cuts less circularly.

We employ the same means for perfecting the hippopotamus, that we do for all the other materials which we use in dental prosthesis. The instruments used are the drill, a small lathe and wheel, with drills of various sizes, drill stock and bow. The end of the drill stock is placed in one of the cavities which are always found on one side of the jaws of the vice of the lathe, or upon the side of the trennel, the other extremity is placed upon the object to be pierced.

The orifices made in the hippopotamus, like any other animal substance employed in the construction of pieces of artificial denture, should always be rather smaller than larger than the points which they receive, because it would not be well adjusted if we were not to use some force, in order to introduce them there. The perforation of these orifices also demands certain precautions. Thus, it is necessary that the gimblets which are employed should be well grooved; otherwise the cut particle will not escape or be taken up by the gimblet which will become heated, lose its temper, bend and break. This inconvenience may be prevented by often withdrawing and emptying the hole and dipping it in water. If it breaks in the piece, and when the part which remains cannot be seized with pincers, we should perforate the piece directly opposite and drive it out with a small punch. Finally, when the work is finished, it should be polished by simple means, such as have been already indicated, but some dentists do it with walnut or willow wheels, slightly moistened, upon which they apply a little emery, putty or protoxide of tin and pulverised pumice-stone; then the process is completed by polishing it with the fingers and dry powdered pumice-stone.

The hippopotamus has particularly this advantage; the same pieces can be often retouched. We employ, for example, that which is ordinarily sufficient for those plaster moulds, we at first make the piece of wax, then we cover the greater part of this mould with black or red, diluted in gummy water, we then place the piece on, and when it is removed it will be marked

with small black or red spots, according to the color employed, indicating the part which requires to be cut out with an engraver, but always with care, so that all the points which should touch the subjacent model should be covered with the color with which the latter is impregnated. As to the method of tinting the hippopotamus, destined for imitating the gums, we shall speak of it in treating of the method of arranging the basis upon which we mount the teeth. Let us content ourselves by saying here, that in order to give to the isolated teeth a yellowish tint approaching to that of the natural teeth, we boil them in a decoction of coffee or tea, or of any other substance containing a little tannin.

The dentist who has a large practice in dental prosthesis should always keep on hand an assortment of the teeth of the hippopotamus of all sizes, so as to have constantly upon hand the form of the enamelled part which he may desire. Those who live in the country and make but few pieces can easily procure them from the workmen of large cities. We cut these teeth in circular pieces of a certain thickness, whiten the enamel upon the grindstone and preserve them for use in a cool place. It is well to be warned that this substance is sold by weight, that merchants keep it in cellars or moist places so that it may absorb humidity and weigh more. It would be well in this case, in drying it, to be careful to not expose it to the sun, nor to too much air, because it would cause it to crack, particularly in the seams or unenamelled parts.

Human Teeth.

Does it not seem, in the first place, that no indication of prosthesis could be more easily and more surely fulfilled than that which is relative to the teeth, since we cannot only replace nature by nature itself, but we can directly substitute for a human tooth one exactly similar. Three reasons are urged to prove, that the use of human teeth has not been as frequent as we might suppose, and have engaged men of art to seek substitutes, which might have their advantages without their inconveniences.

First, their use has been necessarily interdicted, or nearly

void by those people whose religious belief considered it as an act of sacrilegious profanation to touch or despoil the dead ; then, again, many persons have a great repugnance to having teeth which had belonged to others in their mouth ; finally, they have to be frequently renewed, because they have that in common with all animal substances which lose their brilliancy and color, they form a striking contrast with the neighboring teeth, and are attacked and destroyed by the saliva and other fluids of the mouth. They also, at certain times exhale a very disagreeable odor.

However strong these reasons are, they have yielded to the want which many have experienced, who have been deprived of their teeth, of hiding this loss ; thus the human teeth are sought by those who prefer a perfect imitation of their own. In times of war, very beautiful and healthy ones, corresponding exactly to their own, can be procured ; but in times of peace, we can seldom obtain them, except in two ways : we buy them from the infirmaries or hospitals, and from cemeteries. As to the hope which Delabarre gives to dentists, of being able to procure enough by the extraction of *supernumerary* teeth, we have never known it to be realized ; and we would caution young practitioners never to depend upon this source for their procurement ; first, because supernumerary teeth are *very rare* ; secondly, because, amongst those which we extract, it is very rare that we have one whose form is sufficiently perfect to be useful ; the most of them resemble simple osseous tubercles, which approach more to canines than to any of the others, as we have already observed.

In regard to teeth taken from cemeteries, they are always *bad*, because, when they have remained a long time in the earth, their enamel is frequently changed, and, most ordinarily, the osseous substance has commenced to decompose, which renders them yellow and brittle.

The last thing to be noticed, is the manner of choosing the human teeth, and the processes through which they should be passed, previously to being used. The best ones are those which are neither caried nor cracked, which have been extracted, a short time after death, from individuals, aged from

twenty to forty years, a period of life when they are best capable of resisting the various forces to which they are necessarily subjected. When they are taken from younger subjects, they are less resisting, and have too large a central cavity; upon subjects more advanced in age, they are already yellow and worn. It is necessary to select such as are entirely healthy, and to reject all which, although untouched, and have a reddish or blackish appearance interiorly, because this color is the result of a pathological state, and which, like decayed teeth, are soon destroyed by contact with the saliva. With regard to what some authors say concerning the filling of those places which are slightly decayed, with hippopotamus, it should not be done by any dentist who attempts to make a perfect operation.

In the purchase of human teeth, we should place more value upon the six anterior teeth of the superior jaw, particularly to the incisors, which we have occasion more frequently to use; we must not, however, neglect to procure those of the inferior jaw, which we use as frequently as any other.

When they are selected, they should be freed from tartar, and the periosteum and portions of the alveoli, with a scraper. Some dentists then perforate their roots, and string them on a thread; then, before fitting to the mouth, they soak them eight days in simple water, renewed every twenty-four hours; then clean them again, with a piece of tender wood, slightly softened, and covered with a little pulverized pumice stone; then they rub them with silk, and, finally, they terminate the cleaning by washing them, and leaving them several days in soap and water. Others commence with this last operation, and also boil them in water. Although this precaution seems to give more security, as it regards their cleanliness, yet it does not appear to us to compensate for the tendency which the osseous part has to become yellow; we therefore abstain from it.

If some slight spots remain, which cannot be removed by rubbing the hand upon them, they should be removed by submitting them to the action of a wheel of tender wood, mounted upon a lathe; and if the enamel is slightly attacked, the discoloration may be removed by placing them upon a grindstone; we then polish with a wooden wheel and the dust of dry pumice stone.

In no case should the teeth be cleaned with concentrated acid, because the enamel would be acted upon by it, and doubtless sooner than if the teeth were living. It is well to observe, however, that the care which we should take to select the most beautiful teeth, should not go so far as to reject all those which have some defect of color or form, because some of these might suit exactly to a case which might present itself. It is because a complete assortment of teeth is not constantly kept on hand, that trouble is frequently experienced in finding such as have a perfect resemblance to those which we wish to replace; inconveniences which the manufacturers of mineral teeth have partially overcome.

The teeth selected, cleaned, and arranged in sets or by series of incisors and canines, &c., it only remains to provide for their preservation. For doing this, each dentist has a method which he thinks preferable to every other. Some leave them in simple water, or alcohol diluted with water; others cover them with a layer of white wax, oil and chalk, or keep them in lard; others, again, preserve them dry, in drawers filled with bran or flaxseed. These three processes have each their inconveniences: First, teeth, on being taken from water, and exposed to the air, crack; as regards the second, the teeth become yellow in proportion as the greasy substance in which they are kept acquires rancidity; and teeth kept in the manner last described, are liable to crack.

It is better to preserve the incisors and canines by implanting their roots in wax. This method, which we were the first to employ, is excellent; not only for preserving them, but also for enabling one to select readily the ones which he may desire. The advantage which it has over the method of keeping them in bran or flaxseed is, that being arranged in sets by the side of each other, they may be easily compared with those by the side of which they are to be placed; and over the method of preserving them in water, it enables one to distinguish their true color more readily.

Mineral Teeth.

If in supplying an artificial piece, the dentist has but one object in view, and that to perform the functions of the organ which formerly held its place, either for the mastication of aliments or the articulation of sounds, and of exactly imitating nature in form and color, the employment of human teeth would, at once, solve the problem. But by the side of these two questions of the identity of use and of perfect imitation, we find a third which they are far from fulfilling by the tendency which they have, as all animal substances, to progressively deteriorate. It is that which is relative to their preservation. It is not then astonishing that we have sought to replace lost teeth by a substance that joins unalterability to durability and color, and it is evident that we cannot find this substance within the *animal* and *vegetable* kingdoms; it can only be found in the *mineral* kingdom.

History of their discovery.—To whom truly belongs the merit of the first discovery and manufacture of these teeth? Some say to an apothecary of St. Germani, named Duchateau, who, in order to remove the inconvenience of an artificial denture constantly undergoing decomposition, and giving forth a disagreeable odor, fabricated a hard porcelain denture and communicated his discovery to the Royal Academy of Surgery in 1776. Others, on the contrary, say, to Dubois-Chemant, surgeon of Paris, who struck with the disagreeable odor of the breath of a lady, whose gums were becoming diseased by the contact of the denture of hippopotamus which she had worn for a long time, and, which was in a complete state of decomposition, conceived the idea of manufacturing a porcelain set of artificial teeth, and presented the result of his labors in 1789, not to the Royal Academy of Surgery, as Delabarre erroneously supposes, but to the Society of Medicine, of which it is said, it was coldly received by its members.

Not to the prejudice of either of these individuals do we say, that it was to Fauchard the credit belongs of first suggesting the substitution of mineral for animal substance for artificial teeth; to be convinced of this, it will only be necessary to refer

to chapter xix of his work, entitled manner of enamelling the teeth or *artificial dentures*, where he thus expresses himself:

"I have thought that advantage might be derived from a regular and unalterable coloration from enamel *artificially composed*; I have also thought that I might from this not only perfectly imitate the enamel of the teeth, but the gum, in cases where it is necessary to replace the teeth in whole or in parts of sets. With a view to success, I have consulted the most able enamellers, and by the conversations which I have had with them, I have rendered practicable that which I believed no one else has ever thought of. We have imitated the natural eyes with artificial enamelled eyes; but we have neglected the application of this art to pieces of artificial dentures; however, besides all the advantages which artificial teeth have over enamelled eyes, they serve, as these, to ornament and at the same time to repair deficiencies of parts whose deformities displease or offend the sight."

It seems to us clearly demonstrated by this passage, that Fauchard not only imitated the enamel, but still more the different shadings of which the natural teeth are composed. "In order that the enamel may be better prepared," says he, "we should endeavor to imitate those by the side of which the artificial teeth are to be placed." "We cannot doubt, then," says Audibran, "with reason, that Fauchard employed different coloring materials in his enamels." Certainly, it was not far from this period when the invention of artificial teeth made entirely of porcelain was made; that which Fauchard adds, strengthens still more our conjectures. "The advantages of enamel employed for artificial teeth," said he, "is not only confined to the ornament which it furnishes, but from it there is a still greater result, the teeth, or enamelled dentures of the same, *will exist a very considerable time, since the enamel is a substance scarcely susceptible of change or alteration.*" We have had for some time in our possession a piece made by Fauchard himself, and which proves the truth of the observation of Audibran.

It is impossible, as we see, to demonstrate in the clearest manner the principal advantages of teeth composed entirely or in part of mineral substances; it is evident that, the necessity of

employing an incorruptible material and nearly unalterable, being well established, there was nothing to do but to pass from the enamel to porcelain.* Now, had Fauchard been inspired by the writings of Guilman, who, before the publication of his treatise had given, for artificial teeth, the formula of a paste composed of *white wax*, softened with a little *gum elemi*, and in which is added a powder of *white mastic*, of *coral* and of *pearl*? We do not admit even this supposition, and every one must at once perceive, without being too much in favor of Fauchard, that there is an infinitely greater difference between his enamelled teeth and the composition of Guilman, than between these teeth and those which are used at the present day.

As to the person to whom we must positively attribute the merit of that which we call more an invention than perfection, it seems to be well established, though Delabarre has said of it that it is the apothecary Duchateau, for whom Dubois-Chemant had obtained the secret and perfected the work, of which he had had the precaution to secure a brevet of invention.†

It was, unfortunately, of mineral teeth, as of a great many other things, the praises of Dubois-Chemant, whom we were obliged to regard as their inventor, were as hurtful to their propagation, as the epigrams of those whose interest it was to oppose them. In short, whilst this practitioner discontinued proscribing all substances which, until then, had been employed for the construction of teeth, and attempted to demonstrate, in an emphatically written pamphlet,‡ that the employment of human teeth might cause the most serious diseases, his opponents, on the other hand, endeavored to establish, through the Journals, that mineral teeth were dangerous, be-

* We find, also, in a work entitled *Researches and Observations upon all the parts of the Art of the Dentist*, published in 1756, by BOURDET, that this distinguished practitioner, who flattered himself to have studied and understood the treatise of Fauchard, has employed rose enamel in order to form the gums of some pieces of artificial teeth.

† See the *Annals of Arts and Manufacturer*, vol. 15, p. 141.

‡ *Dissertation upon the Advantages of New Teeth, and Denture without odor*. Paris, 1789.

cause they dissolved in the mouth and caused a metallic taste which incommoded and injured the health of those who used them. Fatigued by this contest, Dubois-Chemant went to England, where he transported his industry, and took also a brevet of invention.

About fifteen years after Dubois Foucou, one of those who most bitterly opposed the use of mineral teeth, renounced his prejudice, and sought to correct the imperfections of a procedure which appeared to have, from the method adopted, the advantage of securing greater durability to these teeth. His first attempts did not wholly succeed, because his teeth, made of tender porcelain, softened and finally decomposed in the mouth, under the influence of the buccal fluids. He was not, however, discouraged; he made farther efforts, and not only arrived at advantageous results, but he had still more, the credit by the publication of a dissertation, in which he made it a duty to throw no mystery in relation to his researches,* of fixing the attention of his professional brethren on this new procedure, and of exciting their emulation.

Dubois Foucou, like the rest of those who were engaged in the fabrication of mineral teeth, prepared the artificial pieces in blocks comprising several teeth united together. To M. Fonzi occurred the happy idea of making single teeth, and attaching them to a plate by means of little platina cramps, which were introduced into the paste before it was burned, remaining firmly fixed after this process was completed. This innovation called forth a very favorable report from the Athenæum of Arts, which awarded to M. Fonzi a medal and crown, although he withheld the knowledge of the preparation of his pieces, which he designated by the name of *terro-metallic teeth*, or *caliodontes*, (flint teeth.)

Since the time of M. Fonzi, there have been many improvements in the manufacture of mineral teeth, and it may well be believed, that the greatest degree of perfection possible has now been reached. We will present the details of their composition, which it is indispensable should be known, even to

* Exposition of a New Method for Manufacturing Composition Teeth.

those who will find it impossible to devote any attention to their manufacture.

General Composition.—Mineral teeth, in imitation of human teeth, are composed of two substances: one is the paste or body of the tooth, refractory and opaque, which is called the *base*; the other is vitrifiable, slightly transparent, possessing the clear and life-like hue of the surface of the human teeth; this is the enamel; and is known in this connection, as the *covering* of the base. The base is nothing more than the porcelain earth, called, in commerce, *kaolin*, or the argillaceous earth of Limoges, (*argiliform feld-spar*.) The covering is the *petunsé*, or flint of Limoges, (*granulous feld-spar*,) which is used for the enamel of porcelain; the fusibility and transparency of this substance, however, it is necessary to modify by the addition of a little kaolin.

These two substances suffice for the composition of ordinary porcelain, which is not to be *exposed to the action of fire*; but as mineral teeth are required, after being burned, to undergo intense heat, as, for instance, that attendant upon the process of soldering, an infusible substance is added, such as sand, *grés*, (a sort of brown free stone,) silex or the earth of Vanvres, already burned, which, by isolating the earthy molecules, furnish the substance with imperceptible pores, through which the caloric diffuses itself without causing too forcible and sudden an expansion. For this reason the base or paste is generally formed as follows:

Porcelain paste of the manufactories, . . . 20 parts.

Sand, *grés*, or white silex, 1 part.

And the enamel, or covering:

Enamel, of the porcelain manufactories, 5 or 6 parts.

Porcelain clay, 3 parts.*

Coloring.—But if we were to be content to use these substances only in the manufacture of mineral teeth, we should have teeth perfectly white, and, of course, unlike the natural teeth: it is absolutely necessary, then, to find means of giving

* This large proportion of earth gives to the mass only a half fusibility; the oxydes used for coloring, give it all that is required in this respect.

them a permanent color, varied with all the shades of the natural teeth. This means has been found in the addition of certain metallic oxydes, of which the various degrees of oxydation produce shades very varied, *even such as bear no resemblance to their primitive colors*; for instance: gold, in leaves, well mixed with the paste, or enamel, gives a *violet*; hydro-chlorate of potassium, *red*; the grey or yellow, hydro-chlorate of platinum give the first, *blue*, the second, *black*, etc., etc.

Authors, who have written upon the subject, have not been perfectly agreed in relation to the coloring properties of the various oxydes; this diversity of opinion has arisen, doubtless, as much from the different quantities in which they have been used as from their mutual combination, i. e., the influence they mutually exercise upon each other; but particularly from the various degrees of heat to which they are subjected by the manufacturer.

Dubois Foucon, whose processes were, certainly, very different and very far inferior to those followed at the present day, was perfectly aware of the coloring power of the metallic oxydes, for thirty years ago, he said:* “The principal earth which serves as a base to the different materials which enter into the compound forming the paste, may be colored by the addition of metallic substances alone, in the state of oxydes, or combined with other kinds of earths or sands. I limit the coloring of the teeth to three principal shades: *white-blue*, *white-grey*, and *white-yellow*.” For the first shade he made use of *terre de rénard*, and *terre d’ombre*, calcined, to which he also added a small quantity of *cobalt*, when he wished to obtain a deeper blue; for the second shade he employed the *terre de Dourdan et d’ombre*; for the third, which he found more difficult to obtain, he proposed the use of *frittés* or *calcinés*:† the first composed of *manganese*, *sand of Belville*, and *petunsé*, the second of *petunsé* and *terre d’ombre*, to which he added the last named material to produce a deeper yellow.

* Ouvrage cite.

† In the language of the manufactory, is thus termed each burning of the substances used for coloring, either the base or covering used in the manufacture of mineral teeth, or the enamel for the gums.

M. Delabarre used *cobalt* to produce a blue color; *platinum* for black-white; *gold* for violet and red; *bismuth* for blue-grey; *mercury* for grey; *silver* for white-yellow; *iron* for red-yellow; *manganese* for grey; *uranium* and *titanium* for yellow-straw; and, finally, *antimony* for pure yellow.

M. Audibran used no other materials for this purpose, than the oxydes of *titanium*, *zinc*, *uranium* and *gold*, to which he added the *hydro-chlorate-ammoniac of platinum*, and filings of *platinum* and *gold*.

Maury advised the use of the oxydes of *bismuth*, *platinum*, *gold*, *titanium*, *uranium*, the *chromate of barytes*, *hydro-chlorate of tin*, the *chlorure of gold*, the *red precipitate of Cassius*,* and *tungstic acid*.

M. Lefoulon believed, that by adding to the argilacious earth of Limoges, (kaolin,) to the earth of *Vanvres*, already burned, and to the petunsé, or flint of Limoges, the oxydes of *titanium*, *uranium*, *manganese*, *gold*, and the filings of *platinum*, all the desired shades, from the lightest to the deepest, might be obtained.

As for ourselves, we think that with the following preparations, with which, moreover, experience has proved that the tints can be varied by the different degrees of heat in burning, results can be obtained which will supply all our ordinary wants.

FIRST SHADE.—(Yellow-grey, wine-yellow, yellow-grey-blue, in accordance with the degree of heat in burning.)

Paste:

Kaolin,	3 kilog.	(6 lbs.)
Tungstate of iron,	64 gram.	(2 oz.)
Per-oxyde of manganese,	96 gram.	(3 oz.)
Oxyde of gold,	4 gram.	(1 grain.)

Enamel:

Petunse,	1 kilog. 500 gram.	(3 lbs.)
Oxyde of titanium,	32 gram.	(1 oz.)

* This term is used to designate the metallic precipitate of gold, which results from the union of the proto-hydro-chlorate of tin, and hydro-chlorate of gold, concentrated, the last in excess.

The oxyde of gold should be prepared as follows: Dissolve four grains of gold in a compound of four parts muriatic to one part nitric-acid—evaporate.

SECOND SHADE.—(Yellow.)

Paste :

Kaolin,	3 kilog.	(6 lbs.)
Earth of Vanvres,	1 kilog.	(2 lbs.)
Earth d'Ombre,	16 gram.	(4 grains.)

Enamel :

Petunse,	1 kilog. 500 gram.	(3 lbs.)
Tungstic oxyde,	48 gram.	(12 gr.)

THIRD SHADE.—(Yellow-grey.)

Paste :

Same as the preceding.

Enamel :

Petunse,	1 kilog. 500 gram.	(3 lbs.)
Tungstic oxyde,	32 gram.	(1 oz.)

FOURTH SHADE.—(Yellow-blue.)

Paste :

Kaolin,	3 kilog.	(6 lbs.)
Oxyde of cobalt,	16 gram.	(4 lbs.)

Enamel :

Petunse,	1 kilog. 500 gram.	(3 lbs.)
Oxyde of manganese,	48 gram.	(12 gr.)

FIFTH SHADE.—(Pure Grey.)

Paste :

Kaolin,	3 kilogs.	(6 lbs.)
Tungstate of iron,	64 gram.,	(2 oz.)
Oxyde of manganese,	64 gram.	(2 oz.)
Oxyde of gold,	4 gram.	(1 gr.)

Enamel :

Petunse,	1 kilog. 500 gram.	(3 lbs.)
Oxyde of platinum,	2 gram.	(36 gr.)

There is another kind of mineral teeth which many practitioners find superior to those obtained by the different combinations of which we have been treating; these are called transparent, and, also, English teeth. In order to give the best information about these teeth, which has yet been fur-

nished, we think we cannot do better than to publish that which we have from M. Billard, and we promise most of our readers to notice the work* of this honorable brother, to whom we owe some of the finest productions in the way of mineral teeth. The different points of view in which he looks at the manufacture of mineral teeth should interest every one engaged in the profession, for he treats of them not only as a manufacturer, but examines them as a practitioner. We here give the letter which he has had the politeness to transmit to us, and which we feel it a duty to make public :

“MY DEAR AND HONORED BROTHER :

“In reply to the flattering request you have made of me to furnish you with some information about my method of manufacturing teeth, I send you some facts which may tend to aid those who propose directing their attention in this channel. The various pastes and enamels of our porcelain manufacturers, as well as for coloring, the oxydes indicated by those who have written upon this specialty of our art, may be used without inconvenience. The whole difficulty, which will be met with, is in their proper combination, which should be effected with a determinate degree of heat ; a defect in this particular often puts at fault the experience of the practitioner, and gives results which are altogether contrary to his hopes and expectations.

“In my work upon mineral teeth, I have already given some information on this subject, without, however, presenting the formula ; for to give it without, at the same time, indicating the precautions to be observed, and the means which my practice and experience have put in my possession, to use these formulas satisfactorily, would be to expose my readers to the liability of failures which they would attribute to erroneous statements on my part.

* *Des dents Minerales ou Considerations generales sur les Differentes Substances Employees*, etc. in 8vo. We take this occasion to mention, that M. Billard has practised his profession for fifteen years, which renders him very competent authority in matters of this kind.

"As a work written by you, however, should embrace all that comes within the range of the dental art, and as you desire some information respecting the new teeth, known as *transparent* or *mineral-natural* teeth, which are now manufactured. I here give you all that I can furnish. These kind of teeth may be burned in an ordinary furnace, or in the fire of a porcelain manufacturer. In the first case, where a simple furnace is employed, petunsé is used, to which we add a given quantity of potassium, which may be varied from a tenth to a twentieth part; for coloring, we use the oxydes of titanium, of iron, (the titanium being well washed,) those procured from the tungstate of iron, the tungstic acids and oxydes, the peroxyde of manganese, the oxydes of cobalt, of bromium, of uranium, of manganese, or even the original mineral substances, such as titanium, the tungstate of iron, the substances known in commerce as *terre d'ombre*, *terre de Sienne*, and, finally, all the substances usually indicated for the coloring of ordinary teeth. All are equally proper to give good results. It would be superfluous to indicate the precautions with which they should be used, for it is always necessary to combine them by aid of the fire to the action of which they are submitted, and this can only be effected properly by frequent trials.

"When the reverberating furnace is employed, or even the least powerful fire of the porcelain manufacturer, silica or sand is to be made to enter into the composition of these transparent teeth; this, however, it is necessary, first, to reduce to silicate of potassium, and then to abstract the potassium by the aid of sulphuric acid; by this means a *mineral gelatine*, more or less white, is obtained—the mass is then mixed in different proportions, as may be desired, with the argiles, earths, and coloring matters, and, if the combinations have been well calculated, with relation to the intensity and duration of the heat, to which they are to be submitted, the finest results will be obtained.

"Such are, my dear brother, the facts in relation to the transparent mineral teeth which I have the honor to commu-

nicate to you, and which I authorize you to publish in your work, if you find them sufficiently interesting.

“LE DOCTEUR BILLARD.

“PARIS, April 28, 1843.”

We will close our remarks in relation to the coloring of mineral teeth, by observing that the oxydes used, should be reduced to an impalpable powder. For this purpose, even at the present time, plates and mullers of glass or porcelain are used, but, the latter material is the only kind that should be employed. M. Billard has invented a very ingenious mill for this purpose: it is a vase, from the bottom of which is a conoid projection, destined to receive the pierced bottom of another vase, which is set in this one, but which does not touch in its circumference; the latter is turned by a handle and grinds by its base, substances introduced between the two vases.

Preparation and Management of the Paste.—Whatever may be used for the composition of the base, we take a certain quantity of the paste which we have indicated above, (mixed, sometimes, with a small quantity of covering or enamel to give it transparency and to shade it more easily,) to which we add such oxydes as are judged necessary, in the proportion of thirty grains to a pound; these are mixed with care, keeping the mass constantly wetted upon a porcelain table, with a muller of the same substance; for this purpose, glass should never be used. This is now dried as much as possible, and made into little oblong squares, about a line and a half in thickness, three or four in width, and five or six in length, these various dimensions will always be a little reduced by contraction.

At this stage of the process, little grooves horizontal or vertical, and sometimes in the form of a cross are to be made on the back face of these little squares, which are still soft, and rounded on their lateral edges; instead of making the paste into these squares it is better, as we shall hereafter describe, to mould it in forms or matrices of copper made as nearly as possible in the form of the teeth. This groove is destined to

receive the little curved platina cramps which are to form one or more projections above the plane of the teeth, to which are afterwards to be soldered, the gold or platina shaft, which serves to mount the tooth.

As the strength of the artificial set depends upon the solidity of these cramps, their implantation is a part of the process which is quite important, and their preparation requires care. They are made in several ways: sometimes a platina wire of ordinary thickness is taken, passed through a draw-plate, flattened and cut into proper lengths; sometimes the wire is simply passed through a flattener, and when it is divided the extremity which is to be fixed in the paste is cut off with a pair of cutting forceps. Again, finally, this extremity is divided and the two parts turned in contrary directions.

But nothing is more variable than the form given to the part of these cramps which extend above the paste. Some put two, three, or four of them, terminating, exteriorly, by as many isolated projections, sometimes placed upon the same line, sometimes distributed in equal or unequal numbers on each side of the groove. Others curve them outward, in the form of one or even two rings destined to receive a little metallic shaft, either vertical or horizontal; others, again, fix to the cramps a little groove, also of metal, which makes one with them, filling the groove in which they are buried, and is destined, as the rings just described, to give attachment to the metallic shaft upon which the teeth are to be mounted. Some manufacturers are contented to leave these cramps simply at the bottom of the groove in the paste and afterwards to solder the shaft upon their external face.

We have indicated the various methods of arranging the cramps exteriorly because they are those which are followed at the present time; but it is evident that, for the most part, they are defective, and for these reasons: when a tooth is to be mounted, it is necessary to solder the metallic shaft, which is introduced between these cramps; now, this is one more heating of the tooth than is necessary, (for, of course, this soldering does not obviate the necessity of again resorting to the same process to fix the tooth to the plate,) and this complicates the operation.

To obviate these inconveniences, we have fixed in the paste before burning, not simply cramps, but, a piece of metal, forming at once the cramps and the tenor or shaft by which the tooth is to be fixed to the plate. This fixture is composed of a central shaft, from each side of which go off, in the form of wings, little cramps which pass into the paste and disappear in it. Fastened in this manner there is no risk of the fixture becoming defective by the vice of one of these cramps, all being attached to and making one with the principal piece; this is not the case with the old method in which it was sufficient for a single hook to become detached from the shaft to compromise the solidity of the whole. As experience has demonstrated to us the advantages of this procedure, we advise our professional brethren to adopt it.

M. Billard* maintains, that the method of manufacturing mineral teeth, so that a piece of platinum occupies the place of the groove intended for the cramps, seductive as it appears, is, however, defective, because the piece of platinum when the tooth is burned, will, in consequence of the expansion of the metal, in opposition to the contraction of the paste, cause the latter to crack. We beg pardon of our honorable brother, to whom on all proper occasions, we have, heretofore, rendered justice, but we have facts to prove that this objection has no force, for out of a thousand teeth, thus made, sometimes scarcely two are found cracked. Reason, too, demonstrates the same, for the dilatation of the metal compensating for the contraction of the paste, the relations of the two parts remains the same; and if, against all probability, however, this contraction should exceed the expansion it will only be the superficial layers which will not be completely in contact with the metal; but on the one hand the visible part of the cramps serves to keep the paste sufficiently united to the metal, which it covers, a little, and, on the other side the cramps are not less firmly fixed for giving the piece the necessary solidity than if they were mounted by another method.

The best proof besides, that, in our method, the paste does

* Work quoted.

not separate from the metal during the burning, and that the tooth does not crack, is, that, generally, the metal is fixed, like a kernel in the paste, and that if the external layers on this side have some flaws they can be most easily removed by the grindstone.

Mineral Teeth with a Talon.—The implantation of the cramps in the posterior faces of mineral teeth, is intended for those, only, of which this posterior or internal face is flattened, and which form rather simple *facades* of teeth, than entire teeth; but mineral teeth are often made to resemble, in all points, at least of the crown, the natural teeth; that is, they are furnished behind or interiorly with a *talon* or heel. This heel is formed in three ways: either by making it continuous with the crown before burning, adding it with a substance of the same nature after it is burnt; or, finally, making it with a metallic substance soldered to the cramps of those teeth of which we have just spoken, as being most commonly employed.

The first method is simply to construct a tooth precisely like a natural tooth, (an incisor or canine,) in form, and, in the thickness of the projection backward, upon the middle of the upper surface, to make a vertical hole; in this hole are fixed the cramps destined to be soldered to the shaft or pivot which is to fill this hole, or to a little metallic tube to receive the shaft. The greater part of the transparent or English teeth are made in this way.* The force of adaptation which holds these tubes united to the paste, after the burning, is another proof that the objection which has been urged against our cramps is not well founded, for this tube, in consequence of its form, is more liable to dilate by the action of the fire and crack the substance in which it is placed, than a little simple piece of metal; yet, from this cause, the teeth are never cracked.

* To make these tubes, a band of platina is used, the edges of which are brought together by passing it through a draw-plate. M. Billard, proposes to make them of a band of platina, one line in width, turned in a spiral form. It may be observed, that the tube could be made in a single piece, but then it would be more costly.

By the second method the pivot is first soldered to the cramps of the common plate tooth; after this is done, the projection, which gives it the form of a perfect tooth, is added: the substance of which this is made, is composed, according to the formula of M. Delabarre, as follows: Porcelain paste, seven parts; calcined gypsum, one part; white sand, one-twentieth part of the whole mass; such oxyde as may be desired, four ounces, six grains, to the two pounds. As the addition of gypsum greatly augments the fusibility of this paste it is entirely unnecessary to resort to the furnace of the porcelain manufacturer, a simple air-furnace is generally sufficient. We regard this method as very defective, first, because the paste added is united with difficulty to the first, from which it is separated by a piece of platinum, then, not being as well burnt as the tooth itself it will be less able to support the shocks to which it will be subject. It is, therefore, a much more simple and certain process, when these teeth are required, to make them at once of the desired shape, or to make the projection of platinum, and solder the pivot to it.

Whilst some authors have exaggerated the advantages of the pivot teeth, others have improperly proscribed them entirely. These latter, to support their objection, give a very bad reason in saying, that the heel renders them difficult to mount, because, in so delicate a question as the insertion of artificial teeth no difficulties of this kind should be regarded when the result will be advantageous; and they condemn our art in declaring, that the teeth we have been describing, continually receiving the shock of the increasing lower teeth, are shaken and loosened, as this difficulty could be readily avoided by making the projection less than the usual size, or by grinding it down, so as to prevent any possible shock capable of producing injurious effects.

The question of the utility of mineral teeth with a *talon*, can only be determined, therefore, when the cases in which they may be advantageously employed can be established. An attentive examination of this question has brought us to the following conclusions: the flat teeth, suffice perfectly, in general, when they are to be mounted upon the front part of a metallic

plate; but a tooth, with a *talon*, will be found useful in replacing single tooth, particularly in the lower jaw, because, when mounted on a pivot, they cover the entire roots, and then the tongue finds no unpleasant breach, and nothing can get between the root and the artificial tooth.

Molar Mineral Teeth.—All that we have said of the proper form to be given to mineral teeth and the various methods of attaching them, has relation to the canine and incisor teeth, only; but molar teeth are also made, the form of which vary according as they are to be mounted in front of the exterior border of the plate, or base, destined to receive them, or immediately upon this plate. In the first case the artificial tooth is formed precisely like the natural one, except the lingual side, which is left flattened. This side is furnished with cramps exactly similar to those intended to replace the incisores. In the second case they are made in all points like the natural teeth. The question now arises, how are these teeth to be attached to the plate? In several ways:

1. In each of the sides of the tooth, corresponding to the dental interstices, a depression is made, into which the cramps are fixed;
2. A vertical hole is made which passes nearly up to the surface of the crown; into this passes a pivot fixed to the plate, and through the upper part of this pivot a pin is introduced horizontally through a little hole previously made for this purpose;
3. The tooth is pierced with a horizontal hole, near the top, through which a platina wire is passed, bent down to the plate on each side and soldered;
4. A vertical hole is made entirely through, larger toward the crown than at the base; a pivot is fixed to the plate and passed through the hole, the top of the pivot is capped, and the whole soldered together, thus fixing the tooth.

This last method is recommended by M. Lefoulon,* and is, certainly, the most defective of all, because it has the great objection of leaving upon the grinding surface a large and very visible spot. It will be replied to this objection that the same is the case when a decayed tooth is plugged on the grinding surface; but in this case, no choice of means is left with the artificial teeth.

* Ouvrage cite, p. 417.

Sometimes a piece comprising two or three molar teeth is made. In such case a hole is pierced through the middle one, destined to receive a pivot soldered to the plate; in the two others a groove is made into which pivots pass to keep the whole piece in place,* unless it is preferred to make the grooves on the lingual or internal side and solder it, like the incisor teeth.

Preparation and Manner of Using the Enamel.—To make enamel, as much of the mass already described, as is desired, is taken, and to it is added, such metallic oxydes, or such a combination of them, as is necessary to obtain the desired shade; in quantities of about an ounce at a time, grinding the whole, perfectly, upon a porcelain table in order to distribute equally the coloring matter. In order to obtain a color more homogeneous to the enamel, we may use, with advantage, a paste made of an enamel already burned, and broken up in a mortar. This may be regarded as a color already well formed.

The enamel paste should be ground with more care than that of the base; the more perfectly this is done the more free will be the surface of the tooth from spots, and the more uniform will it appear. It may be preserved in water, if the precaution be taken to remove it from time to time, and it be used at about the consistence of a thick paste; and, in order that it should attach itself to the earthy base it should be diluted with water in which some gum arabic has been dissolved; finally, it is applied in a thin layer, if the base is colored, and in a thicker one if the contrary is the case.

This application of the enamel to the paste is made in two ways: either by first putting the enamel in the mould, and then the paste, making the groove and fixing the cramps after this is done; or, on the contrary, the tooth is first moulded, the groove made, the cramps fixed, and then the enamel ap-

* For the better comprehension of what we mean by the anterior and posterior surfaces of the molar teeth, we will remind the reader that they are those which correspond to the dental interstices; the two others are the lingual or internal and the external which corresponds to the cheek.

plied. The first plan which has been longest in use is defective in this, that the paste, placed upon the soft enamel, buries itself always more or less by its own weight and by the pressure necessarily occasioned by making the groove and fixing the cramps; the inevitable result is, that the layer of enamel is very unequally spread over the surface of the tooth. This may be proved by grinding half away two teeth enamelled by these two plans, in one the paste will be seen to describe a regular curved line, whilst in the other it will be irregular. The second plan, although less varied, easy, and, perhaps, a little more certain in the fire, is, however, always preferable; it is the one we always adopt, and which is recommended by those who are most versed in the manufacture of mineral teeth.*

Manner of Burning and of Uniting by means of the Fire the Base and Enamel.—When the teeth (formed in the mould) are sufficiently dry, and the enamel has become adhered to the paste, they are put in the furnace, being previously arranged on a *gazette*,† sprinkled with sand, side by side, but sufficiently distant from each other to prevent them from touching as they would become adherent from the fusion of the enamel, during the burning, if this were allowed. It is also indispensable, that the face upon which the enamel is spread should be placed horizontally as, when it liquifies, it will always run down to the lowest part.

It has for a long time been believed, or pretended to be believed, that no one could make mineral teeth but those who were living in the vicinity of manufactories of fine pottery, or those who possess large furnaces. This is an error which those dentists, who hope to make a monopoly of this manufacture, are very careful not to attempt to remove; it is, however, demonstrated now, that a small furnace, with a hearth eight or ten inches in diameter, twelve or fifteen deep, fifteen to eighteen high, is quite sufficient for this purpose. These furnaces can be obtained ready made or may be constructed of bricks.

* See on this subject the work of M. BILLARD, already cited.

† A species of plate made of refractory earth.

These furnaces being constructed, and arranged with the necessary apartments and muffles, to prevent the teeth from contact with the combustible material, and charged with charcoal, it now becomes important to be able to ascertain exactly, from time to time, the condition of the teeth, for no certain calculation, from the duration of the burning or the quantity of combustible material used, can be made, since the amount and intensity of the heat may vary according to the state of the atmosphere. For this purpose recourse is had to various means: 1. To ascertain by a platina calorimeter, the degree to which any composition has been heated; by the use of a Wedgewood pyrometer, by means of which the degree of heat is ascertained by means of pieces of alumine, drawn from time to time from the furnace and applied to the scale of the instrument; 2d. By fixing samples of the composition to platina wires, placing them in the common apartment of the furnace and withdrawing them from time to time. This last process being the most simple and economical is that to which we give the preference.

It will be known, when the paste is approaching the proper degree of burning, when the samples, which should be taken alternately from below and from the middle, have assumed a pale yellow color, can no longer be cut away with the file, and have taken the semi-transparency of porcelain; the fire should then be gradually extinguished by turning down the grate of the furnace. If the composition is withdrawn too soon, before the enamel is vitrified, it will be rugged and change in the mouth; if, on the contrary, it is allowed to remain too long, the color becomes paler, the enamel evaporates, and, finally, becomes black or is burnt. It should not be forgotten that the teeth should be allowed completely to cool in the receptacle in which they are burned, for if they are withdrawn they will crack and even split to pieces on being suddenly exposed to a cool temperature.

But even when guided by these principles, it will be necessary to make many trials; trials, too, surrounded with deceptions, before success can be expected. The manufacture of mineral teeth is composed of so many elements, that in a work

of this kind, devoted, as it is, to the general principles of our art, only simple generalities should be presented. The details are, indeed, so difficult to master fully that it is not always done even when the processes are seen. We believe, therefore, after having given a recapitulation of our knowledge on the subject, that we cannot do better than to quote, in justification of our position, what has been said by M. Billard in relation to the difficulties attending the manufacture of mineral teeth.

"The fabrication of mineral teeth does not consist, principally, in knowing the substances, primary or secondary, which are used, as the paste and enamel, but those which give their proper quality to these teeth, rendering them harder, more compact in their interior, little liable to break or be injured in the fire. Upon these points it is particularly difficult to impart any profitable instruction. There are, besides, other difficulties attendant upon particular localities: thus, the paste and enamel of which I make use are obtained from the porcelain manufactories of Paris; I prepare my compositions to be burnt in the furnaces of these establishments, because my pastes and enamels being the same as those used in the factories, the heat is just in the proper relation—I only add the substances which give them the proper color, and render them harder, without making them more or less fusible than in their original condition. Dentists living at a distance from Paris would, therefore, be deceived, if I were to attempt to present any rules to guide them, as these could not be general; for, in the different manufactories, the pastes and enamels are combined differently, and bear more or less perfectly the substances which it is necessary to add in the manufacture of teeth. Thus, any thing I might say in relation to the substances which ought to be used in making proper pastes and enamels could not be correct, since the earths used differ in France, England, Germany, and the United States, and in different parts of the same countries, as the differences between the porcelain manufactured in these places shows. In different countries, then, each manufacturer should modify his composition. Finally, I always manufacture, myself, the substances I use in making my compositions and I am thus enabled to know, exactly, the

quantity of mineral or metals I incorporate with it; this can never be the case when these articles are purchased, already prepared, as, for instance, the oxyde of gold, as the salts, or precipitating metal, enter in a certain weight, in greater or less proportions, it is impossible to know exactly the amount of coloring metal which it contains."

Manner of Finishing Mineral Teeth.—However near in form to the natural teeth may be those manufactured according to the rules which we have laid down, it is very rarely the case that we are able to use them as they come from the furnace, or rather from the mould, for they undergo no alteration in burning. It is vain that they are selected from the same classes they are intended to replace, that is, incisores for incisores, canines for canines, and so on; it will always be found necessary to reduce them somewhat in size, either to render them more like the natural teeth near which they may be placed, to accommodate them to the vacancy they are to fill, or, finally, to fit them to the bases upon which they are mounted. For this purpose a small lathe grindstone, mounted in the usual manner, is used. This stone is, generally, about from eight to twelve inches in diameter. Some dentists, Maury, for instance, recommends one from twelve to twenty inches, while others are satisfied with a stone much smaller, from six to eight inches, which they turn with the hand. Both are in error: the first, because the stone recommended is of too great dimensions, is inconvenient, and will never cut, regularly, so small an article as a tooth from which there is, sometimes, so little to be removed that a half revolution is sufficient to effect it; the second, because so small a stone would cut too slowly.

In all cases, however, whether these stones are large or small, their circumference is cut into ridges, by means of a piece of steel, or the point of a bad file; these ridges enable the dentist to cut away the tooth in every part, and in every direction. Finally, they turn vertically, and the lower edge is plunged in a trough filled with water; upon this trough is a little cover to catch the teeth when they slip from the hand, it is pierced with holes so as to allow the water to pass back into the trough. In addition to these stones, it will be found useful

to have one about six inches in diameter, and about four lines in thickness, mounted in a similar manner to those used by glass-cutters and lapidaries; it is moistened so as to answer the desired purpose. As to the stones of soft iron or steel-plate, which some authors praise so extravagantly, we hardly think they are necessary; we should prefer the little vegeto-mineral stones, recommended by M. Billard, if experience did not convince us, every day, that the ordinary stones, rendered familiar by constant use, answer almost every purpose.

It is necessary, sometimes, to remove small portions which cannot be reached by the stone, this is done by means of a file charged with a species of sandstone slightly moistened. For some time, too, round files of a composition nearly resembling the vegeto-mineral stones of which we have just spoken, and which are both nothing more than pieces of wood or iron, covered with gum lac, charged with emery. If the mineral teeth are too much rounded on the external surface, this part may be ground down on the stone, and afterwards polished with wood sprinkled with finely pulverized pumice; and to render the polish more perfect, pumice still more finely powdered is used without being moistened, as in the former case.

Finally, a part of the upper surface of the anterior part of the incisor and canine teeth may be cut away, by means of the file and stone alternately, for the purpose of fixing a piece of red wax with which some persons are satisfied to imitate the gums.

4. *Recapitulation of the Qualities of the Substances used in the construction of Artificial Substitutes, and the cases to which they are Applicable.*—Authors and practitioners are very well agreed at the present time, in relation to the substances used for artificial teeth, and advise the use of human teeth, the ivory of the hippopotamus tusk, and mineral teeth; but few among them venture, formally, to give the preference to any, or even to indicate the cases to which they appear to be particularly applicable. It is important, however, in order to prevent the young practitioner from making fruitless attempts which would compel him to incur expense and compromise his reputation, that

he should be enabled to have general rules, in relation to the subject, constantly in his mind. We will, therefore, present what reason and experience have demonstrated to us.

When a single tooth is to be replaced, the hippopotamus tusk is least suitable for the purpose; for when deprived of its enamel, it quickly becomes yellow, and if the enamel is allowed to remain, it can never be made to accord with the adjoining teeth. In such cases, therefore, we give preference to the natural teeth, and sometimes to the mineral teeth; to the first, in general, when a single tooth is to be pivoted on the natural root, and when there is room enough for the backward projection; first, because it is easier to find a tooth which will accord, perfectly, in form and color with the adjoining teeth, and because the heel continues perfectly back of the curvature of the alveolar ridge; to the second, when the superior jaw, or for the inferior in the case of a *menton de galoche*, (jimber-jaw,) there is not room for the heel in consequence of the length or situation of the antagonist tooth.

When a continuous series of artificial teeth are to be inserted, due regard being had to what we are about to say in relation to the matter, natural or mineral teeth may be used indiscriminately, but where the series is interrupted by the presence of teeth still remaining, that is, where they will be between the artificials, natural teeth are best, as they can always be found better to accord in color with those which remain. We are very well aware that this is not the opinion of the partizans of mineral teeth; as they regard them as so much better, that there are few cases, and some go so far as to say, that there is not a single case, in which the preference should not be given to them. The following extract will show their views in relation to the subject.

"If you desire to select a mineral tooth which will perfectly correspond to the natural tooth which is next to the vacancy to be supplied, you will cry out against the imperfection of the invention to meet your wants, and you have reason to do so;* but now take a natural tooth for the same purpose and

* *Memorie cite, p. 8 et suivantes.*

do you suppose you will escape difficulties? First, you must find a tooth bearing an exact resemblance to those which remains, and it is excessively difficult to find one precisely similar in form, in dimension, and in the direction of its lines; it becomes necessary to alter the shape of the tooth, you will cut down its edges, perhaps you will round or flatten its surface. Then you will have failed in attaining your object, for it will no longer have a natural form, and will easily be distinguished in the mouth. With a natural tooth which precisely resembles the one you wish to replace, you will encounter difficulties of another species: the dental canal, if it is a pivot tooth you are inserting, will be of a different size from that of the dental canal of the root, and you will find that it either projects beyond, or sets further in the mouth than the adjoining tooth; the setting of a natural tooth, is therefore surrounded with more difficulties than the setting of a mineral tooth. Another difficulty may present itself with a natural tooth; if you have not allowed it to remain at least a day in water, before selecting it, it will afterwards acquire a different shade from the other teeth to which, when first inserted, it may have corresponded precisely."

We perceive, in this comparative view, that the advocates of the mineral teeth are at least as much embarrassed to find objections to the natural teeth as to overcome the difficulties attendant upon their insertion. Let us see if their objections are well founded. These objections rest upon the difficulty of matching them with teeth remaining in the mouth, the necessity of altering their size and shape, the diversity of the dental canal of the artificial tooth and the root upon which it is to be pivoted and finally the necessity of selecting the desired tooth from among such as have been tempered in water previous to the selection.

As to the difficulty of finding a tooth to correspond perfectly to any natural teeth which may be remaining in the mouth, it can only exist with those who have a small number of teeth to select from, or who have acquired the bad habit of procuring for their use, such teeth only as have a fine and beautiful shade, rejecting all others. As to the necessity of altering

them in size or form, by grinding, this can rarely occur with those who have a large number to select from, and even if it should be found desirable, it should always be taken away from parts which are not visible, and never from the anterior face. The only remaining objection against human artificial teeth, then, is the difficulty of fitting the central canal opposite to that of the root; this, of course, is confined to pivot teeth, and can be obviated by a stroke of the file making the pivot larger in some particular direction, by including the tooth, by arching it, or making the pivot diverge from a straight line.

The objections to mineral teeth, rest, unfortunately, on better grounds. We will say nothing here of their fragility which is feared by persons, only, who are ignorant of their composition, nor the difficulties which are found in mounting them, as these soon are overcome by practice; but there is peculiar brilliancy, especially in the light, which, for the most part, prevents their being inserted next to any teeth which may be remaining in the front part of the mouth. We are well aware, that this excessive brilliancy may be lessened and even removed entirely by the grindstone; but there is danger of falling into an opposite difficulty, and it becomes necessary for the tooth to be covered with saliva in order to recover the necessary brilliancy, but it always remains unpolished, and is readily tarnished. This objection, it is true, holds only for interrupted sets, for when there is a continuous set, the brilliancy is uniform and not unpleasing. But it cannot be contested, for it can be shown, indeed, from the avowal of advocates of the mineral teeth, that it is difficult for very nervous persons to become accustomed to the friction and shock of two substances of this nature. M. Billard, who is pre-eminent for having extolled teeth, cites the case of a person in whom, "the contact of a metallic plate (covered with mineral teeth) produced a sensation of cold and numbness, resulting from a continual disengagement of galvanic fluid produced by the mixture of metals, and which in spite of the efforts which were made to become accustomed to the set of mineral teeth, which were preferred to those of any other kind, the patient was at last com-

pelled to resort to a set carved from ivory." We have many times met with similar phenomena.*

For the construction of complete sets, the ivory of the hippopotamus tusk is a precious substance, the advantages of which no one will dispute. First, it is very easy to work, and if the color changes in time, the change is so regular and uniform as to offer no unpleasant contrasts of different parts of the set. This substance is particularly valuable, too, for the purpose of making bases upon which to mount either natural or mineral teeth, particularly with persons who find it difficult to accustom themselves to artificial sets. Nevertheless, very excellent, entire and partial, sets of mineral teeth are put up on metallic bases, and this method is the only one suitable for those persons in whose mouths the fluids are of such a nature as quickly to injure the natural teeth, or those made of hippopotamus.

Young practitioners should also be made aware, that they will meet with sensitive persons who will obstinately refuse to wear human artificial teeth. It is certainly a prejudice which causes this repugnance, but we cannot see that any thing is to be gained by combatting it, it is better, in our opinion, to conform to the wishes of such patients; the most important thing we have to do, indeed, is to consult the tastes of our patient when they do not demand anything which would conflict with the principles of our art.

We are confined, in our efforts, to repair the losses of nature, to human teeth, those made of the hippopotamus tusk, and mineral teeth, such as they are at the present day. But if our efforts in approaching nature very nearly have been quite happy, we have not entirely succeeded; and even if nothing should be wanting as regards the imitation of nature, still there are always improvements which ingenuity and economy will prompt.

* As this effect may, perhaps, be attributed to the simple contact of the plate with the gum, we would observe, that, even if the fact, that the result is infinitely more rare when the plates are surmounted by natural teeth, did not render the matter indisputable, the phenomenon readily finds an explication in the diversity of metals in the plate and teeth. See, for more ample information in relation to this subject, the *Traité de Physique Médicale* de M. PELLETAN, etc. etc.

To speak only with regard to mineral teeth, would it not be desirable if some person out of the dental profession, but scientifically acquainted with the manufacture of pottery, glass and porcelain, should travel out of the beaten track, and be enabled to dispense with kaolin as a base? No doubt, then but that he would find, in some compound, fuller's earth, provided it would become white in burning, as pipe-clay, with an infusible sand very much divided, and a small quantity of white glass, adding a proper and sufficient quantity of the metallic oxydes, a mixture, as M. Delabarre judiciously remarked twenty years ago, for making teeth which would be so much the more solid, as they could not be burned except at a very high temperature.

SECTION 2.—*Of the Metals used in the Dental Prosthesis.*

The first of all qualities which metals, destined for the purpose of uniting and fixing artificial teeth in the mouth, should be, that of remaining unchanged when exposed to the action of the saliva and the various fluids which are secreted from the mouth and digestive passages; for, undergoing a change from the action of these agents, salts may be formed which will exercise a dangerous influence on the health; for instance, if copper were used, verdigris would be produced, and silver would oxydise; and even if the change undergone were not injurious to the health, the metal itself is as liable to be destroyed as iron.

We have two metals, which are used in preference to any other, and these possess those desirable qualities, and have besides, the advantage of being firm enough to offer all the necessary resistance, and still malleable enough to be easily worked: these metals are gold and platina. Silver, alone, should never be used, because the gas coming from the lungs possesses the property of blackening and changing it to a sulphuret which produces a strong and unpleasant taste in the mouth. As it is, besides, too soft for the purpose, in its pure state, the addition of some copper is necessary to diminish its malleability, and this would make it dangerous; it should never be used,

indeed, even for the purpose of fixtures which are to remain in the mouth, temporarily, as those intended for the correction of irregularities, and the fixing of loose teeth. Practitioners of the last century, and even those at the commencement of this, have recommended silver for such purposes, as is proved by the sentence of Fauchard which follows: "If teeth should lean too much out of their proper position, and cannot be held by a thread, it is necessary to make use of a plate of gold or *silver*;"* and this, from Laforgue:† "Gold, platinum, or *silver*, should be annealed to prevent them from breaking, and yet be hard enough not to bend when they are buried in the roots."

Of Gold and of its Use.—The ancient dentists employed, for dental prosthesis, gold, almost to the exclusion of all other metals. Its beautiful color, its ductility and the facility with which it may be mixed with other metals, in order to render it a compound susceptible of being employed, gave it certainly a preference over all other metals until the discovery of platina. We find it in commerce in a pure or alloyed state. Pure or fine, is called twenty-four carat gold.‡ Many pieces of money, as the ducats of Hanover, of Denmark, and of Holland, are nearly of this kind; but in this state it is so ductile that it yields to the slightest pressure; it is this kind which we employ, reduced to thin leaves, for *plugging* the cavities of decayed teeth; but in wire for ligatures, pure gold, united in certain proportions with silver, forms what is called green gold; it is necessarily more consistent than fine gold, but it is rendered still more hard by being united with copper.

For commercial purposes gold has three legal proportions:

The 1st, is to 22 carats $\frac{2}{3}$ nds, $\frac{1}{2}$.

The 2d, is to 20 carats $\frac{5}{8}$ nds, $\frac{1}{4}$.

The 3d, is to 18 carats 000.

* Ouvrage cite, tome ii, p. 96.

† Ouvrage cite, tome ii, p. 17.

‡ The word carat comes from the Arab *kyrat*, (weights which are worth in Mecca the 24th part of a pennyweight.) It expresses, in our language, the degree of purity of gold, and always denotes, whatever may be the quantity of this metal, the 24th part of its mass. Gold, supposed *perfectly pure*, is 24 carat gold; if the metals that we have alloyed with it are one twenty-fourth, it is only 23, and so on.

This last standard is that which jewellers generally employ in the manufacture of jewelry, as we see, three-quarters only is pure gold, and one-quarter of alloy or brass. This gold has a reddish color, and is altogether harder than the other and finer qualities; when rolled and hammered, it is very elastic and resisting, and may be used for clasps and resorts; but it is not sufficiently soft to be used for plates for teeth; for this purpose we are obliged to employ gold from nineteen to twenty carats fine; in this state it preserves its beautiful yellow color, oxydizes but little, and has nearly the consistence of platina.

In large cities, dentists can easily procure all the gold which they need; but in small cities, and even in those of ordinary size, they have not this advantage, and cannot procure it from the jewellers, for they have it fabricated and stamped, or not fabricated, but then only eighteen carat gold; they can use the different pieces of money met with in commerce, and whose exact standard they should know in order to add the exact quantity of brass necessary for the purposes for which it may be designed. French coin is between twenty-one and twenty carats; the English coin is more than twenty-two; consequently, we reduce the first to the standard most frequently used, by adding a twentieth of brass, and the second by adding a greater quantity.

From the following we observe the manner of proceeding. If we wish to have gold twenty carats, we take a piece of 20 francs, which is 21 carats $\frac{1}{3}$, and which weighs 6 grammes, 5 decigrammes, we add to it 67 centigrammes of brass; if we wish to have 18 carat gold, we add to this piece of 20 francs, 1 gramme, 5 decigrammes, etc. etc. We hammer the two metals into little pieces, and we place them in a Hessian crucible, or one of any other fabrication, we then add a little borax: we place this crucible in the midst of a coal fire; then cover it with a piece of tile, and blow the fire, strongly, with a bellows about half an hour. If, at the moment, we uncover the crucible, we see the metal melted and brilliant; we then take this crucible with a pair of tongs, and turn the gold into an iron receptacle which we call an *ingot mould*, which we

have had the precaution to heat and to rub with a greasy body as oil or tallow. When the product obtained is cooling, we forge it with a hammer, on an anvil, first in one, then in another direction, heating it from time to time to a red heat, until it is forged into the form we wish it to have.

We perceive that the operation has succeeded when the gold is ductile, or forges without cracking. When the ingot elongates its molecules heap up more and more, or, in other words, the metal settles. We make it into wire or plate according as we wish to have it. But in this case we are obliged to heat it often to a red heat, this we call annealing, in order to keep it soft or ductile, so as to prevent it from breaking or cracking in elongating it.

We will add, although it may be known to every one, that the method of testing in a brief but ready manner, the different standards of gold, consists in tracing two or three lines with the object we wish to test, upon a black and hard flint, known under the name of *touch-stone*; then we plunge a long crystal stopper into a bottle of nitric acid, known in commerce under the name of strong water, and touch the traced lines. If these lines preserve their yellow and metallic brilliancy, we infer that the gold has its legal standard, namely, eighteen carats. If, on the contrary, the line takes a reddish brown color, like brass; and if a great portion is removed, we conclude it is of an inferior standard, and lower in proportion as the trace is more readily removed.

Platina and its Use.—It has not been a century since platina, (vulgarly called *white-gold*,) has been known, and it has not been more than forty years employed by dentists. Its discovery and introduction in the arts has been a valuable resource, because it preserves great consistence, although very malleable, and it is least of all mineral substances affected by chemical agents, and by the buccal humors.*

* The deep and cloudy tint platina sometimes acquires in the mouth of some persons affected with certain diseases is not a true oxydation, for the metal does not lose its polish, the slightest rubbing will restore its ordinary brilliancy.

This precious mineral, is valued not so much for its real value, since, at the present day, it is not worth more than a third as much as gold, as for the service it renders, is found in many parts of the East Indies, principally at Choco, Barbadoes, St. Domingo, Brazil, and even in many parts of Siberia. It is usually found in small flat grains, containing besides platina, a very great number of metals; more of sulphur, of silex, etc. We meet with it, however, sometimes, weighing from a half to one kilogram. When it has not been forged, its specific gravity is 20.98, (that of gold being 19.257;) it is not as good a conductor of caloric as silver or brass.*

When pure, platina is of a grey color, which equals the brilliancy of silver. This metal resists the action of the most violent blows of the forge, and is not affected by any of the simple acids; it resists even the action of cold mercury, which, in this state dissolves silver, gold and brass. Furthermore, it being about a twentieth heavier than gold, we would prefer it to this latter in the construction of artificial pieces, not being liable to melt by the action of fire, it can be worked with more facility than any other metal, because we can always solder together two parts of platina with gold or silver, whatever may be their standards, and because we can employ many different solders upon a plate without melting or diffusing it.

We make with platina and gold, cast in a very intense fire, in the proportions of a fourth of the first, and three-fourths of the second, an alloy which has a clear rose color, which renders it more convenient for ligatures, because it is less apparent and more tenacious than gold or platina alone.

M. Delabarre, finding that 20 carat gold, and even platina, alone, are too ductile for certain purposes, as thin plates, and which he wished to have as solid as 18 carat gold, has proposed to make a double plate of platina, which has all the solidity of this latter, without having the unpleasantness which the fourth of brass, which enters in its composition, communi-

* See, for more ample details of this mineral, Vacquelin, Berzelius, Davy, Laugier, Dumas, Orfila, in their general treatises on Chemistry.

cates, and which, without rendering it dangerous, gives a brassy taste. In order to accomplish that, he placed a very thin gold plate, 20 carats fine, between the two leaves of platina, fastened them by two rivets, and soldered them by the fusion of the intermediate leaf. It then being reduced thoroughly, composed the necessary thickness.

These plates might have the advantage; but as dental prosthesis has many more difficulties to overcome, and greater, assuredly, than those which belong to the working of metals, we would advise our young professional brethren to employ, in making plates, platina, which possesses sufficient properties, and to never forget, that in dental prosthesis, the construction of pieces is not the only object, but that their adjustment, and the opportunity of their application is the principal end; it is of this that we shall now treat.

We should not, however, omit to say here, that palladium is, also, an excellent metal for making very light plates. Being equally pure, it comes not so dear as platina; for being lighter, it gives, all things equal besides, a greater surface. It has, however, over this latter metal the inconvenience of being harder and of oxydizing. We are astonished that dentists have not oftener employed it.

Soldering of Gold and of Platina.—Every one knows that we call *soldering* the operation which has for its object the union of any two metals, or rather, the forming of one by means of another metal which we employ, so to speak as a cement. Three conditions are necessary in order that this operation shall succeed; the first is, that the metal which we employ to form the union, must be fusible at a lower temperature than those which are to be united, or shall be most effected by the fire during the operation; the second is, that these metals must be sufficiently heated in order that their molecules may, if not in the deep layers, at least in their superficial ones, be penetrated by the intermediate metal: the third is, that the fusion of this metal must be aided by the action of another substance; for this we use *borax*, (sub-borate of soda.) Gold and platina being, as we assert, the two, not to say the only two,

metals employed in mechanical dentistry at the present day, they are the only ones we shall treat of here.

It is by means of gold that we solder either two pieces of gold, or two pieces of platina, or, in fine, a piece of gold and another of platina. In the first and third cases, that is to say, when we solder two pieces of gold, or one of gold and another of platina, the gold employed for soldering should be of the inferior standard to that of the pieces we wish to unite. Thus, if this latter is 20 carats, we should use an alloy composed of three parts of 18 carat gold, two parts of fine silver and one of red copper; we melt the whole in a crucible, roll the solder which results from this melting, as thin as paper, and preserve it for use in the form of particles from two to three, and even four millimetres in size, which we designate in the workshop under the name of *papillas*.

But, ordinarily, we solder together two pieces of platina, with fine 24 carat gold. We can, however, employ for this purpose, and it is that we make, of gold at 22, and even at 18 carats fine; but the pieces soldered together with this latter are not so intimately united. It must, however, be known that the solder is as much more solid as the platina upon which we pour it has been more strongly heated. Some dentists employ for this solder green gold, of which we have already spoken, which is merely an alloy of gold and of silver, a metal more consistent than each of its component parts, which we may sometimes render, and without danger, a little firmer by adding to it a very small quantity of copper.

Let that be as it may, we solder the gold and platina by means of a lamp and blow-pipe. An oil lamp having a large wick, is generally preferable to an alcohol one, because it gives a larger flame and more heat; as to the pipe, it is a tube of copper or iron, of a cylindrical form, diminishing in size from that of its extremity which is to be received in the mouth, into the one from whence the air escapes, and where it forms a rounded angle. Notice the different times of the operation. The pieces to solder being perfectly cleaned by a light file, we unite them either by a thread of iron, or by a little diluted plaster; we place, then, by means of a brush covered with a

solution of borax, or with a small pair of pinchers, the pieces of solder upon the proper place, that is to say, upon the line where the two pieces touch, if they are juxta-placed, or upon the superior piece, if they are super-placed; then we slightly heat the whole, without which the borax, which is in a liquid state, might abandon the water in which it is held in solution, and the solder would be disarranged.

If we wish to solder near a point which has been already soldered, we cover the soldered point either with an iron wire or mixture of whitening; the first method is particularly applicable to objects which we wish to envelope circularly; the second to pieces with plain surfaces; in every case, the flame should be directed particularly to the spot upon the solder which we wish, exclusively, to fuse. If we desire, for example, to solder the teeth upon a plate, the teeth being fixed upon this base by means of plaster, as we say, we put the piece upon a small burning chafing dish, we increase the fire so that the piece may be properly heated, whilst the plaster and borax may be dried; being assured that the solder is in the right place, we use the pipe for carrying the whole flame upon this point; under its increasing action, the solder melts and flows upon the parts we wish to be united. We shall treat this subject more particularly when we come to the application of soldering to each object.

The operation terminated, we leave the piece to cool; then we pickle in order to remove all the asperities which might render its surface unequal; then we boil it in a second very light water; this we call precipitating, and which is done in a platina receptacle. If now we should wish to give to the piece a red color which would approach nearer to that of the gums than the yellow gold; and the crotchets, the ligatures, the plates themselves, and in general to all the parts visible to the sight, we should wrap with an iron thread that which we wish to color, and plunge the piece in the same liquid in ebullition. But we can only obtain this red color, a true oxydation, by dipping it many times; if we pass the degree wished, it becomes a blackish red. This color once obtained, should we polish the piece, and even burnish it as some au-

thors advise? No ; for, in polishing it too much we prevent it from adhering to the parts, and, in giving it brilliancy, we render it more apparent.

The preceding is a summary knowledge, which the dentist should possess, of those metals which he most habitually employs ; we might here advise him to keep mercury away from these metals which he might have need of in the construction of the dorcet metal or any thing else ; for, by its contact, it renders them brittle by the great tendency it has to amalgamate with them.

Manner of taking Impressions, of making Moulds, of Adjusting and Stamping Plates or Bases of the different pieces of Artificial Dentures.†

When the arts of imitation were still in their infancy, dentists were content, in the construction of pieces of artificial dentures, to take only summary dimensions of these pieces, and to work them in the presence of their patient, from whom they required long and laborious sittings. But, in proportion as the arts progressed, means are expected of us which permit at the same time a more perfect imitation of nature and the greatest possible economy of time. We proceed then to take exact impressions even from the mouths of persons, to procure moulds from these impressions, and to use these latter in the construction of the work.

We do not know precisely to what author is due this happy invention, which opened an easier way for dental prosthesis, by conducting right to the end, and by drawing to us persons who removed the uncertainties and doubts of the ancient pro-

* "If, in spite of all we have done to render the metal very brilliant, it is not sufficiently so, it must be burnished with care," (AUDIBRAN'S work quoted, page 181.)

† We shall only treat here of metallic bases, upon which the attention should be most particularly fixed, as being the most used ; the construction of hippopotamus bases having been noticed whilst treating of that substance, and those of mineral paste in a summary manner at the same time.

ceedings. This is very certain, that neither Fauchard, "nor even Bourdet, whose work was of 1756, made mention of it; they speak only of taking *measures for commencing pieces*, which they complete as they themselves say, *only by trying them in the mouth*.

The first work in which it is spoken of, is the report that the medical society published in 1789, upon the *incorruptible teeth* of Chemant, and in which it is said that this practitioner took *moulds with wax*, upon which *he poured* plaster, and thus obtained *exact models*. However, Laforgue, in the first edition of his treatise, which appeared twelve or thirteen years later (1802) adopted still the ancient method; but, in 1805, Gariot recommended *taking impressions*, and in 1808, Dubois Foucou gave a description not less clear than minute; then, as soon as the following year, Maggiola spoke of it as of a definite conquest acquired to the art, and placed it in the number of its improvements that were the least equivocal; and in his second edition, which appeared in 1810, Laforgue adopted it, notwithstanding his antipathy for innovations which were not made by him. All the authors which have written since, have recommended this method with reason, as an excellent one, for which nothing better has been used; we have also described it, with all the proper details, and particularly one manner clearer, which has not been done until the present day.

Of Impressions or Moulds in Wax.

Until the present, wax has been employed for taking impressions. Most ordinarily, it is virgin wax; some dentists, however, employ yellow, such as we find in commerce, whilst some authors prefer that which is colored in rouge with the addition of a little turpentine. These different kinds of wax having appeared too soft and too easy to be deformed, Maury has proposed to make some composed of two parts of white wax, one of white lead, and one-half of grease, the whole colored with cochineal; but, the odor which the grease always takes in heating, would always prevent this composi-

tion from becoming generally used, cleanliness being an important matter in every thing ; if, on the other hand, the white of lead, which *probably* is the carbonate of lead, or *white lead*, had not poisonous properties which should interdict the use of it ; we, therefore, give the preference to virgin wax.

We advise the use of wax after two methods ; in the first case, after having softened it before the fire, or preferably in warm water, and having removed the humidity from it by pressing it in a linen cloth, in order to soften it anew in the hollow of the hand, finally, by rendering it perfectly homogeneous and free from every fissure, and all lumps, we make a roll of it of the thickness of the thumb, which we feature and to which we give primitively the form of the part of the dental arch that we wish to imitate, by having the precaution to hold it thicker in the places where there are spaces, and particularly to fill the alveolar vacuums ; then we make the teeth and toothless parts penetrate this mass by raising it so far that the gums may be enclosed ; we press it inwardly and outwardly with the fingers. We then free this mould by removing it with the greatest precaution in the same direction with the axis of the teeth ; then, when it becomes firm, we wipe out with a badger-brush the saliva or blood which it might contain ; we remove, with every precaution, every thing which appears useless, as much inwardly as outwardly, and at the extremities.

In the other method, we place the wax in a box, a kind of semi-elliptical gutter of tin or silver, upon the anterior part of which is a shaft which forms a handle. The walls of this receptacle, offering some resistance, oppose the deformation of the wax. We apply it upon the place which we wish to imitate, by placing it in such a manner upon this that there will be left an impression of the neighboring teeth upon each side ; then we remove the apparel by following with care the direction of the teeth ; we then plunge it in cold water, and remove with a delicate cutting instrument all the superfluous parts which are about the circumference. This method of proceeding is far from having the advantages which authors generally suppose ; it is in the first place painful for the patient, because

it requires a greater pressure than the method which is executed by means of the fingers which permits strength, more or less great, to be applied, according to the sensibility of the parts, and by smaller portions at once ; finally, it always gives too large impressions, for we cannot press against the walls, as we can with the fingers. We never use it, and advise it to be abandoned.

The teeth to be replaced not being always upon the same side, we should, in certain cases, in order to obtain more precision, take separately, with different pieces of wax, the impression of each breach, cut these pieces as if they were destined to imitate the teeth, and preserve them, in order to correct, at a later period, the model. We might find great difficulty in taking the impression of a part of the converging teeth by acting, as we shall show, in a vertical direction, because that part of the wax which should touch the gum, being larger than the separation which remains between the teeth towards their free edge, could not pass it without deforming itself. In this case we take the impression, not from above downwardly, or from below upwardly, but from front backwards and from backwards front, with two pieces of separate wax, forming a mould, in two places, similar to two valves.

Most authors think, that in the generality of cases, the simple model, that is to say, the single impression of the defective place, suffices to establish the precise indications. It is, however, as often necessary to have models which indicate the relations of the teeth of the two jaws, or even of those between them. In order to accomplish this, we would advise a double impression to be taken, by letting into a mass of wax ; using, however, the necessary precautions to make the jaws close in the precise way they are accustomed to ; the movement of the jaws should be carefully noticed, to see if the impression is exact. But very often the occlusion of the mouth is such as to destroy the *intermediate ridge* which should separate the jaws, and then we have only a representation of the anterior face of the superior and of the posterior face of the inferior ; thus, this method is only applicable to cases where the jaws have between them a great interval, or strike the one

upon the other. We think it is much better to take the model separately; the habitual dentist would always establish the natural relations by presenting the moulds the one upon the other, having had care to take for an indication some mark.

Now, how shall we proceed to take an impression of a jaw in which no teeth are left, whilst in the other it wants none, or only a few? We, at first, take an exact one of the existing denture, and preserve it for a model; we, afterwards, take an impression of the toothless part, cut the wax, which represents this part, to the presumed height of the absent teeth, the mouth being closed, and adjust the mould with the irregularities of the cutting edge of the existing teeth, in such a manner that it touches equally every where.

Finally, as the places destined to receive the artificial teeth are not always so well arranged that we are not obliged to extract some bad teeth, or some portions of teeth, we should, as far as possible, perform this preliminary operation before taking the impressions. If, nevertheless, the person should not wish to be deprived either of this tooth, or of that root, at the time when we are ready to provide for their replacement (that which would always be less advantageous than to wait for cicatrization,) we might be obliged to take the impression such as it is, that is to say, by proceeding as if the object which should be removed did not remain there, either by cutting this object upon the model in order to adjust the piece, or even by leaving for it a necessary space in the mould, and by filling this space when we extract the tooth.

Of Models or Moulds in Relief.

By confining ourselves to the work that we shall now describe, we might have a good representation, in moulds, of the parts of replacement for which we would provide; but we might not be sufficiently advanced for this, because we would have before the eyes and under the hands nothing of that which is necessary for the construction and adjustment of the pieces; it would be necessary to make a mould in relief for this impression: we employ for this, plaster or sulphur.

For either the one or the other of these substances, we com-

mence by enveloping the impression in a bandage of glazed mastic, of potter's earth, or simply of a paper covered over with paste, so strong, that is to say, so thick that the liquid substance with which we would fill the impression would not break it; about two or three inches in height, the two ends of which, in fine, should be maintained by an iron thread. This preliminary precaution being taken, and the impression well cleaned, even covered with a little oil for the sulphur, we place the pieces of iron thread in the cavities which correspond to the long and separate teeth, in order to sustain or mend them if they have need.

As it regards plaster, we use white, sifted fine, such as figurists use; we dilute it slowly by pouring water into it, until it becomes of the right thickness; once diluted, and before it acquires a certain consistency, we pour it lightly by shaking the impression in different directions in order to drive out the air which might have glided between the two bodies, we finish filling it by pushing the plaster with a stylet in order to thicken it, and make it penetrate into all the anfractuosités. When we employ it, we dispense with enveloping the wax impressions with any bandages; we contented ourselves with holding this latter in our hands for receiving the plaster, and as the mould obtained might not have a base sufficiently thick, we apply it upon a quantity of diluted plaster, to which it adheres, and which we conveniently cut off before it is altogether dry. As it regards the sulphur, for which the bandage is useless, we melt a sufficient quantity of it, and when it is about to congeal, we pour it by layers, and by frequently renewing it we make it extend over all the parts.

Whatever may be the substance employed, when it is hard, we gently present the whole to the fire in order to soften the wax, and to detach it the more readily; then we remove, with a cutting instrument, all the inequalities or superfluities of substance which might cause an error in the construction of the piece. Some persons say, they are content to make moulds of wax; but it is evident that its softness would render it altogether improper for the purpose for which it was designed, which is to adjust upon it metallic plates. It would not serve

as a rectifying model, that is to say, one destined to be preserved in order to be used as an indication in the frequent cases where the mould, which had been employed to make the impression, might have received some alteration.

Of those substances, which we are about to describe, plaster is most generally employed ; it requires, however, to be used while fresh, because, if it is too old, it will not congeal. Some practitioners, in order to give it more hardness, have advised diluting it with Flander's paste, which joiners make use of, (glue;) this mixture, which is nothing more than *plaster of paris*, would be excellent, for it acquires the consistency of stone; but it has the disadvantage of requiring a long time in preparing and of hardening slowly. We often aid the desiccation of plaster by the addition of a little brown free stone. Finally, if the sulphur has the advantage of a certain hardness, it has this great inconvenience that, prepared in the laboratory, it spreads around a very inconvenient and disagreeable vapor. The joining together in their perfectly exact relation of the two moulds, by means of a wheel, with teeth, established in their posterior part by a projecting edge in the one, and a practical cavity in the other, constitutes that which we call *an articulated mould*, indispensable for large pieces. The form of the projections is round or triangular, so also the cavity destined to receive them. Some dentists make but one between the two extremities of the branches represented by the alveolar arch; others by establishing one directly behind each of its two extremities.

One thing which is still very important to know, although few authors speak of it, is, that whatever may be the material employed for making a mould, the diminutions of the impression obtained always exceeds a little the object which we wish to represent, because the latter becomes slightly swollen, which the wax does not sufficiently reduce. The result of this is, that the teeth which form the two sides of the semi-circle are thicker than the natural ones, the space which separates them is necessarily a little straighter, and the piece intended for the place would fit loosely. It is then that it becomes necessary to take impressions in relief, which we have advised to be

taken, separately, for each place where artificial teeth are required; in placing them upon the mould, we shall see how we shall have to file the latter.

Finally; let us terminate that which relates to impressions and to moulds in relief, which they serve to give, by saying that wax employed for this purpose should be new. We should, therefore, melt it in a pan containing boiling water, in order to remove from it all foreign substances; the plaster which adheres to it is precipitated by its weight, the other foreign matters float upon the surface, and may be skimmed off. The mass of wax thus purified and cooled is renewed, and by being poured into saucers previously oiled, is made into cakes most convenient for use.

The Construction of Plates or Cuvettes and Stamping them.

Moulds made with plaster and sulphur, obtained with the precautions we have given, furnish an exact representation of the place that the piece should occupy which we propose to make: this we use for the adjustment of the plates or cuvettes upon which the teeth are to be mounted. This adjustment is made in two ways. First, when they are thin and very large, we partially adapt them to the metallic mould with pincers, aided, sometimes, with the burnisher; we name this in the goldsmith's shop *amboutir*; when thin plates have a certain extent, are strong, and, particularly, when they should make a part of a dentier, or complete piece, they must be *stamped*, that is to say, they must be placed between two moulds, which, receiving them reciprocally, impress upon them the desired form.

In both methods we commence by making a kind of model of plate with a thin leaf of lead, but possessing sufficient resistance to prevent it from becoming too easily deformed; we place it upon the mould, and give it the form the true plate should possess. Then, if we only wish to incorporate the leaf which should form this latter, it being sufficiently annealed, in order to have more malleability or suppleness, is cut upon its pattern, then applied upon the mould of plaster or sulphur, of

which we take the principal dimensions, with which, in a word, we harmonize it as well as possible, by the aid of pincers, until it covers and encaps it exactly; by managing the holes and projections, or filing these latter, which should be enclosed until they are wedged in.

In order to give, more readily, to the plates the projections and depressions they might offer, we have constructed, long since, pincers of different sizes, some of which have one of their ends rounded, in order to be received into the other, which is concave, in the manner of an instrument in a case, of which one has a protuberance which is received into a cavity in the opposite side.

If, on the contrary, we wish a true stamp, we are obliged to substitute for the plaster or sulphur mould, which suffices for the first operation, a mould sufficiently resisting to support the effort of a pressure great enough to stamp the plate. In order to do this we make one of lead, to which we ordinarily add about a sixth of antimony, in composition,* in copper and even in iron, in melting.

For the manner of using the lead composition, we, however, proceed: We place in a wooden box, a quantity of potter's earth, rendered moist, and with which some practitioners place a little sifted sand; we plunge the sulphur or plaster mould carefully in it, sprinkled with a little of the powder of *licopade*, in order to prevent it from adhering to it, and, as this immersion when forced might not give an exact impression, we press the potter's earth up against each side of the mould; we then remove it with great care, so as not to injure the matrix. The lead or composition is next melted in an iron ladle, then it is removed from the fire, and when it has partially cooled, we pour it into the matrix, having, previously, used the precaution to sprinkle it with the powder before mentioned. When it is entirely cold we remove it by means of a hook or

* By composition, we mean two substances, one of which is known under the name of Darcet, and of which we have given the formula; the other is that of type-metal, which is composed of eighty parts of lead twenty of antimony, and a very small-quantity of copper.

file, we next *rectify* it, that is to say, we correct the metallic mould by comparing it to the isolated reliefs which serve then as rectifiers, as we have said.

As it regards the copper mould which we were the first to employ, its construction requires a practice which few dentists possess; we advise this part to be entrusted to brass founders. These moulds are rarely, however, obtained as perfectly as those of lead: they are always to be corrected by the primitive model. Once obtained, we wash it in water to free it from foreign bodies that might adhere to it; we then rub it with soft wood sprinkled with potter's clay.

Although the mould may be in lead, in tin, in composition, or in casting of copper or iron, lead is nearly always preferred for the counter-mould; for it presents the least resistance. In order to obtain this, we place in a wooden box a little fine sand, upon which we place, flat-sided, the mould previously rubbed with a mixture of chalk and water, we then surround it with a ring of pasteboard or sheet iron, about four or five lines from it, but sufficiently secure to retain the lead if it should flow over the mould; we pour this metal on to the thickness of about an inch, and when the whole is cold, we separate the two pieces by means of the hammer. We sometimes make the counter-mould by pouring the melted lead in a box of potter's earth twice as large as the mould, and we drive this latter in before obtaining the exact impression. But this method can only be employed for moulds whose teeth do not present too great limits or too wide spaces, for then we could not separate them from each other; we would be obliged, in this case, to cut the teeth off nearly at the base.

This counter mould once obtained, as in the most simple case, that is in cases where we could adjust them without percussion, cut upon the provisional plate which has served for the pattern, we place it between the mould and counter-mould, we strike upon this latter, regular and moderate blows with the hammer, and, when we are very certain that the plate has not moved from its position, we put the whole together upon the piece of square steel, that we have named an *anvil*, and by means of a punch or steel, or more directly, we strike upon

the counter-mould with a heavy hammer, which acts in the manner of a balance. We remove the plate, cut from it that which we judge to be superfluity of periphery, smooth it with a file, restore the depressions that is necessary for the contour to contain, which the pressure might have changed, and it is very certain that it will adapt itself to the plaster mould for which it has been disposed; if it had any particular imperfections, it would be better remedied then.

Some practitioners, to be certain that all points of the plate touch the parts to which it is applied, warm it and apply to its inner surface a thin layer of wax, then put it in the mouth; the projecting parts, pressing the wax, mark the points which require to be more deeply impressed. This increased precaution may have its advantages, since it conduces to greater precision, but in ordinary cases it can very well be dispensed with, and be resorted to only for pieces of larger dimensions, where an exact co-adaptation is indispensable.

The result of this is, that nothing is more variable than the form of plates or metallic cuvettes. Aside from the common character which they necessarily have, as all the other bases, by presenting them as a whole under the form of a gutter destined to receive and cap the alveolar border, we seldom find two which exactly resemble each other; this is explained by the diversity of surfaces with which they have to be antagonised and harmonised. Some are intended to rest upon a surface perfectly continuous and deprived of teeth: others are interrupted, and pierced with holes or simple slopes for teeth still remaining. These holes or slopes never present an open angle; we usually furnish their circumference with small flat rings, in order to diminish and even to annul the injurious effects which might be produced upon the teeth by the contact of a cutting surface. Finally, the cuvettes are sometimes formed of two pieces by a prolongation passing behind the remaining teeth which they support. This prolongation is either a continuation of the plate itself, or a band attached and soldered; the first is altogether preferable, because, with an equal force and size, it avoids the projection of the soldering, and harmonises better with the part which should support the piece.

These different methods which we have described of raising full moulds and using them for stamping the plates, which at a later period serve as a support for the teeth, are those which have been described by authors up to the present, and followed by most practitioners; but, whatever some may say and others think of them, we have rarely found in the plaster model poured in the first wax mould, the precision necessary in every circumstance. Nearly always in taking a second impression from this mould, in sheet lead, or in any other substance, we have had the trouble of making upon the parts it was intended to cover a plate which would be stamped like it.

This inconvenience suggested to us the idea, when a piece of great extent is required, particularly in the development of a piece in which is contained the anterior portion of the alveolar arch, has suggested the idea, we say, of never stamping the true plate in gold or platina without having first made one of sheet lead sufficiently thin to enable us to adjust it to the parts with our fingers, or by the aid of a burnisher or pincers, and, however, sufficiently firm to be worked without losing the form which it is necessary to give to it.

When this provisional plate is obtained, we try it as often as it is necessary in the mouth, in order to adjust it, until it fits with perfect accuracy, and we then use it for the procurement of another plaster model, by means of which we obtain the true plate, which should be an infallible guide.

Many persons to whom we have described this method of procedure, the only one, according to our opinion, for obtaining plates, cuvettes or bases of perfect accuracy, have objected to it, for the reason, that it not only increases the amount of labor, but that the similitude of the successive objects, taken the one from the other, diminish of necessity as they approach the last, the second mould would be less exact than the first. To this, we reply, that the plate of lead becomes the first mould, since it is not adapted to receive the true plate until we have ascertained that it is perfectly correct.

Certainly, this second plate would become useless if the first was taken with a substance so resisting that it would experience in its general relations, particularly in its anterior

curvature or in the plan upon which each of its angles should bear no marked changes. The wax has not this advantage; it preserves and in the detail certain linear impressions which are not reproduced upon the lead plate, and with more reason upon the one of gold or platina, which should be afterwards stamped; but the linear impressions are altogether insignificant to us; that which is important is the persistence of the form impressed in the mass, the exactness of the whole, consequently the coadaptation of the piece.

This method of taking primitively a stamp in lead has still two other advantages; the first, is of tracing exactly the height that the second plate should have in front, by tracing in a careful manner as much within as without the surface, which should rest upon the gums, and the time when it should stop; the second is economy of material. We cannot then recommend it too highly to practitioners desirous of obtaining correct cuvettes.

However, whatever may be the method chosen for obtaining the cuvettes, that which we cannot repeat too often, and which should always serve as a rule for procedure in their construction, is this, that resting upon the gums, they should form a base capable of modifying the pressure the artificial pieces always exert. As to their size, it should be calculated according to the disposition of the place and extent of the toothless alveolar circle. Then, should a plate rest upon the solid roots? It suffices that it should cover the roots of the teeth. If there are no roots, on the contrary, it should have a certain size and form a kind of gutter capable of embracing the the alveolar border, and even of advancing a little beyond it; this eases the teeth around which the crotchets of the piece are fixed, the piece being then supported by the alveolar border alone, and not upon the teeth.

Let us add that the plates should be so large in every direction that we may make the proper slopes for maintaining the posterior part of the teeth in place. And as the notched places become necessarily straighter, and consequently weaker, we avoid the liability of their bending or breaking by soldering to them a piece of gold wire capable of augmenting in thick-

ness the part which has been increased in length, or what we prefer is to solder to it another plate. This wire may be bent in form of a crotchet (clasp) to embrace the part of the tooth behind which it is placed. It sometimes happens, in this case, that we make a separate plate for each toothless place, and reunite these separate plates by soldering them solidly to a circular piece, made of strong gold or platina wire, rounded upon the side corresponding to the tongue. But it is easy to see, that this method, is inferior to the preceding one; we never adopt it.

If, in a series of anterior teeth, there exists one which deviates so much as scarcely to be seen, it should, in certain cases, be covered by an artificial tooth. This may be done by constructing a guttered plate, pierced with a hole through which the natural deviating tooth should pass; a small vertical edge to which the artificial tooth may be soldered, will furnish a support for it. In the same manner a tardily developed tooth may be covered; and against the extraction of which, we should be particularly guarded, more especially so, when only a small part of its enamelled crown can be seen. But as in its development which occurs sooner or later, although at uncertain periods, it might raise the plate, and cause it to lose its perpendicular position, it is necessary to pierce the latter, so that no obstacle shall oppose its growth or force it to take an improper direction. We have met with many cases in which practitioners, for having disdained this precaution, or ignorant of the nature which induced us to notice the necessity of it, have seen pieces deranged very soon in the construction of which a great deal of skill had been displayed.

*Different Methods of Mounting Pieces of Artificial Dentures, that is to say, of uniting Teeth to their Supports or Bases.**

No pieces of artificial denture, such at least, as belongs to

* See in our introduction, in which we have treated in two separate paragraphs, of the mounting of teeth upon their supports, and of fixing the piece in the mouth.

the substance which we have said was almost exclusively employed, is placed in the mouth without the assistance of another substance, which serves as a *support* or *base*. These supports are pivots, metallic plates, of which we shall now treat, or of bases made of hippopotamus, or any other osseous substances, or even of mineral paste.*

In the infancy of the art, practitioners were content for the retention of a series of artificial teeth united, to string together like beads. "It was only necessary then," says Fauchard, "to pierce each tooth with one or two holes, the one larger than the other, according to the size of the teeth. These holes should be made from one of the lateral parts to the other, in such a manner, that they will correspond to each other, and that the teeth should have the same level that the natural organs had. We pass through these holes two threads of gold or silver, of medium thickness, which should successively be passed through all the teeth; we rivet them by the two ends, then finish, by adjusting the roots of the teeth together if they need it, so that they may be arranged equally upon the gum."

We might have some hesitation in believing that Fauchard maintained it in place, for he advises the method not only for pieces "of two, three or four teeth," but he furthermore adds, what modern authors have forgot to mention, that, "when human teeth are thus used in the piece surpassing the number I have mentioned, (from four to six,) we should, besides that which has been said, apply upon the interior surface of the assemblage, a layer of silver or gold. This layer should be pierced opposite the base of each tooth, as near the gum as possible. These holes give passage to rivets of gold or silver, which serve to rivet them to the teeth which are also previously pierced.†

There is not, as we see, but a step between this method of mounting teeth and some others of which we shall soon speak,

* The pieces in which the teeth and bone are of a single piece, are an exception to this rule, since the tooth never inclines in a direct vertical manner, that is to say, without interruption upon the alveolar border.

† Work quoted, volume ii, p. 220 and following.

particularly those which consist of fixing them upon the forepart of a plate. This difficulty was so much more easily overcome, that Fauchard, in order to vary his method of mounting, made one of a single layer. To do this, he arranged them all together, "by lodging the layer in the thickness of each tooth, by means of a slope, cut upon the posterior side of their base, and by fastening this layer to each tooth by means of two small rivets, the one below the other;" this is very nearly the method which Delabarre attributes to Hellès. But we will return to the consideration of mounting teeth by commencing with the most simple method, namely, pivoting.

Pivot Mountings.

The implantation of a pivot in a tooth, is one of the most common operations of dental prosthesis, but is not, however, one of the least importance, because the solidity of the piece depends, in a great measure, upon it. We implant one or more pivots in a tooth for two reasons; either to fix it directly upon a root, or to mount it upon some base. A tooth mounted for the first of these two reasons, constitutes that, which we commonly call a *pivot tooth*, and its dispositions demand more ease, than we might believe at first sight, for the root of the tooth in which it is to be implanted, requires minute and often difficult preparation.

We shall notice first, in what consists the preparation of this root, not in its relations with the part of the pivot which it should receive, and which, in correct language, forms the *tenon*, the *pivot* being the part implanted in the tooth, but in its relations with the base of this latter; we shall hereafter speak of the fixing of a pivot in an artificial tooth. We shall treat of the methods of effecting the implantation when we come to the different procedures, in virtue of which, the artificial pieces are fixed, and maintained permanently, in the places they should occupy.

Whatever may be the cause of the destruction of a tooth, whether it be exterior violence, or the destructive action of

caries, it is very rare that it is destroyed to the level of the gum ; there nearly always remains some portions of it, which pass the alveolar border, and remain in the place they occupied before they were lost. When these inequalities are considerable, we can easily remove them with a file ; but it is well known, that this instrument acts too slowly when it is necessary to remove a considerable portion, sometimes a third or fourth of a tooth ; in this case, cutting pincers, or a small saw which acts from right to left, in the direction of the gum, except for levelling and smoothing the whole, which should be done with a fine file, conforming to the directions we have given on the resection of the teeth.

Human Teeth Mounted upon a Pivot.

When the implacement is well prepared, that is to say, when the root is filed in such a manner as to present a slightly concave surface, so that the gum may slightly cover it, we then prepare the tooth to be placed there, after having taken, if we think it necessary, an impression of the place of replacement, a precaution which many practitioners dispense with, and and we are of this number, notwithstanding it is recommended by some as the best way of arriving at the most favorable result.

We know that a human tooth often harmonises better with those between which it should be placed ; sometimes, however, a mineral tooth, but rarely a hippopotamus. Admit that it may be a natural tooth, (an incisor for example,) we select a healthy one of the same class, of the same side, of the same color, not, as it is commonly said, of that which it shall replace, but of those on each side of it, for the tooth to be replaced, may, from the cause which has occasioned its loss, have taken a different color from the adjoining teeth ; it might be generally replaced with a similar one, it would be better assuredly to match the adjoining teeth, however, in order to destroy every suspicion of its being an artificial tooth, the patient might wish one presenting the appearance of the lost tooth, he being accustomed to it. We cut it below the level of its neck, in order to try it in the empty space to see if it is

of the right length and breadth. We then place it perpendicularly upon the root, the surface of which having been previously made red, for the purpose of leaving an impression upon it.*

As it regards the place for introducing a pivot for uniting the tooth to the root, it may be ascertained by placing a light layer of wax upon the former, and pressing it upon the latter, which will leave a light mark indicating the proper point, using the precaution to wet the wax so that none of it shall remain in the root; when this is neglected, repeated failures are generally the result. For a contrary reason the base of the artificial tooth should be dry when the wax is placed on it.

The method of placing a pivot in a tooth destined for the replacement of another, has perhaps occupied the attention of dentists too much. There is no author who has written upon the mechanical part of our art, and no practitioner of the present day, so inexperienced in the profession, who has not honestly proposed some method which he believes to be superior to all others. All these methods to the eyes of the dentist, who attaches only a reasonable importance to the details of mechanism, are reduced to two principal orders, according as the pivot does or does not pass through the whole tooth. In the first case, the superior extremity of the pivot is rivetted to the posterior surface of that part of the tooth which joins its cutting edge; in the second case, it is forced or screwed into it.

In either case, the tooth should be previously pierced in a proper direction with a drill smaller than the pivot. If the pivot should afterwards break through, the enamel should be cut away with a grindstone over the termination of the hole made by the drill. If the canal of the tooth is very large, it should be filled with a peg of hippopotamus driven in with a hammer; in the contrary case, however, we enlarge it with a

* It is for this reason, (in endeavoring to imitate the lost tooth,) that we have often, in order to gratify the wish of some of our patients, placed for teeth of a bad color, eroded, decayed and plugged teeth. From thence the necessity of having all qualities of them, as we have previously advised.

broach, directed towards the posterior face of the tooth, because if we approach too near the anterior surface, the presence of the pivot might impart to the enamel an obscure tint. When the hole is made in the tooth, we enlarge it, particularly at its base, and straighten it with an equaliser.

Should we wish the pivot to go through the tooth, we sharpen a piece of gold or platina, larger than the hole in the tooth, and of the desired length, by diminishing the metal which should penetrate it. The entrance having been effected, the pivot should protrude about half a line, the part on the opposite side of the tooth should be taken in a vice, and the protruding part be beat down to the tooth, using the precaution not to let the hammer strike the tooth as it would be liable to injure it.

Sometimes this pivot, instead of being in a single piece, is composed, in the part which enters the tooth, of two pieces, juxta-placed, and perfectly united together. Then we do not rivet it, but separate the two ends which pass through the tooth in order to lay them upon their side. We are careful, however, before we do this, to form with a file or scraper, a groove in the enamel for them to lie in, in order to adapt them perfectly. But this is not a good method for every case.

If the pivot is not to pass through the tooth which has the advantage of not sacrificing the enamel of the superior and interior part of the tooth, we make it in the form of a cone, square or screw; the tooth is apt to move and become deranged when the first is used, and it is often necessary to use a transverse peg in order to retain it; the form of the second gives greater stability to a tooth; but the screw pivot holds a tooth more securely than any other, particularly if the thread of the screw is sufficiently sharp to cut the osseous tissue of the tooth, and far enough from each other. This latter pivot has also this advantage, it permits of cutting away the lower part of the tooth when it interferes with the occlusion of the teeth.

As the six anterior teeth of the upper jaw are more frequently replaced with artificial teeth mounted on pivots, and as their replacement is most important, we have taken these for

an example, but there is nothing to prevent the application of teeth in this way, to the roots of the bicuspidæ. In the latter case, each tooth should have two pivots corresponding to the canals in the roots of these teeth, which should be properly prepared for their reception; if but one pivot is used it should be placed between the two roots, over the inter-alveolar partition, for if it be placed in one of the roots, it will not give sufficient stability to the tooth.

We should not conclude our remarks upon mounting human teeth upon pivots, without observing, that if gold and platina are the two substances most frequently employed for pivots, we, nevertheless, meet with pivots made of bone, and even of wood, which some dentists still use.

Mineral Teeth Mounted upon Pivots.

In treating of all that relates to the fabrication and disposition of mineral teeth, we have described the manner of introducing into their posterior face the crampings, to be united to the pivots, and in virtue of which they may be properly placed and solidly maintained. This union is effected by soldering.

That which we employ for uniting two pieces of platina, and which we shall use in the cases of which we are now about to treat, is gold of variable standards; some use from 14 to 18 carat gold; others from 20 to 22; these latter are, perhaps, right, because gold of 18, and still more at 14, fuses at a much lower temperature than that of 20 or 22, and spreads upon the platina before the latter heats sufficiently to dilate. We have already spoken of this in speaking of solders in general.

Whatever may be said of it, in order to provide a mineral tooth with a pivot, it should not be previously cut, because if it is, the soldering will be liable to break it, we proceed in two manners: we fill the groove of the tooth with a piece of platina, intended to level its posterior face, and upon which we solder the pivot by a second fire, or we rather place the pivot there afterwards. The first method, infinitely preferable, is particularly applicable to plate teeth, whose pivots would incline too much to the anterior to fall upon the middle

part of the root which should receive it; our method of arranging the cramps in mineral paste, dispenses completely with the platina, as we perceive, these cramps, at first, fill the groove and are even with it. The second method is, consequently, more appropriate for pivot teeth.

In the second case, after having filed with care, as we have said, the two pieces which we wish to solder, we cover them, with a small brush, with a solution of borax, but only upon the place where we wish the solder to take effect, we adjust them properly and cover them with a number of small pieces of solder, then we place the tooth either upon a piece of charcoal about the size of a playing card, wrapped with fine wire to prevent it from breaking, upon which the tooth is fastened with cramps of iron wire; or upon a piece of pumice stone, whose numerous inequalities permits the tooth and pivot to be easily adjusted in the reciprocal relations they should sustain to each other; or, in fine, upon a piece of iron wire, which has the same advantages as the pumice stone, besides of heating so readily that the anterior face of the tooth may be made of the same temperature as the posterior.

Thus prepared, we direct upon the solder, by means of a blow-pipe, the flame of a lamp, which should be thrown on it lightly at first, because, if we heat it too briskly, it will be liable to crack the tooth, and it should be kept constantly on the point where we wish the solder to take effect, for the reason that if it is too much diffused or thrown on a wrong point, it will cause the solder to spread over too great a surface, or to flow in a wrong place and affect the solidity of the tooth. In soldering the pivot, the solder is apt to flow upon the part which is to be introduced in the root; to prevent which, it should be previously covered with a paste of Spanish white. It is by the same means that we protect the anterior face of the tooth which is liable to be attached to substance in contact with it, and to be condensed by the heat. If, however, after the operation, the tooth is dirty, or smoked, we can restore its primitive color by passing it through an ordinary fire, and, afterwards, soaking in warm water.

When a mineral tooth, intended to be placed upon pivots, is

previously mounted upon this pivot, introduced, afterwards, in its groove, or, rather, upon a small stem intended to be soldered to it, it often happens, when it is not a talon, this pivot falls upon the anterior part of the root, which should receive it. We then make a slight opening into which for it to be placed. In order to this, the pivot should be curved in the form of a bayonet, before soldering it, or, rather, when it is soldered, we saw into it about two-thirds of its thickness, upon its anterior or external face in order to bend it, and saw it in a similar manner upon its internal face, for the purpose of bending it in a vertical direction. When we have done this, we melt two small pieces of solder on the partially divided angles for the purpose of uniting and strengthening them.

When we wish to mount a tooth upon a gold pivot, the method of procedure is precisely the same, except that the solder must be of an inferior quality, else in forcing it, the gold would also be melted.

After uniting pivots to teeth, we diminish the length of the roots upon which they are placed, we then complete their preparation for the reception of the pivots.

Mounting Teeth upon Plates or Metallic Bases.

Whenever a pivot tooth is used, there must always be a root upon which it may be placed, but although these may be frequently found for the anterior teeth, they are, nevertheless, often wanting. In this case we are compelled to have recourse to other means for the retention of artificial teeth, which are plates or metallic cuvettes.

The manner of preparing these have already been described, we shall now notice the manner of attaching teeth to them.

Human Teeth Mounted upon Plate.

The plate being prepared, we proceed to fit and adjust the teeth to it, after having attached the fixtures to it which are to retain it in the mouth, namely, crotchets, (clasps.) But as it rarely happens that the mould has been preserved perfect, we

take from the plate, put in place a new wax impression, not only of the toothless places which it should cover, but still of the parts which surround it, so that the adjustment of the teeth shall be made in all their definite relations. When we have this impression, we fix the plate in the place where we may wish to have it, fill the impression with plaster or sulphur, and obtain a new mould in relief, upon which the plate rests for the adjustment of the teeth; we cut these of the proper length with a saw or file, but rarely with the latter, we then cover the plate with a little rouge, applying each tooth upon it to mark each point to be removed with the file and engraver; we make the median line the starting point, placing the central incisors first by giving them the proper direction.

As to mounting the teeth, there are several methods of procedure in doing it; fixing them by means of a central pivot; by maintaining them with two lateral pegs, but placed vertically, as the pivot of which there is but one variety; by adjusting with a screw upon the plate soldered to the cuvette, and a peg behind; this gives them much strength, and permits them to be advanced as may be desired. (We are now speaking of human teeth, or teeth of the hippopotamus mounted upon metallic plates.) If we employ one of the two methods, we first place the pivot or the two pegs upon the plate, by piercing the latter through and through, at the place which we intend the tooth to occupy, or which corresponds to the hole in it, which point may be indicated by moistening the plate after having placed upon it a thin layer of wax, and then adjusting the tooth, which leaves a mark or imprint at the proper point; then we solder these pivots upon the convexity of the plate, that is to say, to the side on which we apply the tooth; and when they are solidly fixed, we place the teeth upon them, and rivet them.

Finally, if the pivot is a transverse one, we rivet on the posterior surface of the tooth; if not transverse, we turn with a little wire, and make it enter by the force of co-adaptation in the tooth. But experience proves that transverse pivots, crossing and rivetted on one side or the other are the best, because they do not wear the holes, or allow the pieces to vacillate;

the screw pivots which are so easily placed, and hold the teeth so securely that it is difficult to remove them with pincers; but we think they should be first introduced into the tooth, and, afterwards, into the plate to which they should be rivetted.

Mineral Teeth Mounted upon Plate.

The method of mounting mineral teeth upon plate differs, necessarily, from that of mounting animal teeth. We cannot use those which have been previously carved and baked, we are always obliged to carve them for the occasion. The plate adjusted properly in the mouth, we take a second impression, as before described, so as to secure the proper relative relations between them and the plate, and which have been altered; we adapt the teeth upon the plate, one by one, and retain them there for the time being, by means of wax placed behind them; then we place the piece upon a small plate of iron, and pour upon its anterior part a mixture of plaster, which, becoming dry, maintains the teeth in the place they should occupy, and which permits the wax, after being warmed, to be removed; then we solder them to the plate. We, moreover, give to them greater solidity by soldering to their posterior surface small plates of platina. After having tried the piece in the mouth of the patient, such corrections as may be necessary should be made, noticing if the mouth closes naturally, &c.

Mounting upon plate is not confined to one or more teeth as is the case with pivots. It may be resorted to for all kinds of pieces, from one tooth to a complete denture, and serves for *continued* as well as *interrupted* dentures. By the latter term, we mean pieces between the teeth, of which intervals are left for teeth, which may be remaining in the mouth; and this kind is most frequently met with in practice, and has the greatest variety of forms.

When the part of the alveolar border, upon which we wish to place an artificial piece, has experienced a great loss of substance, we oftener mount this piece upon a base of hippopotamus, which permits us to imitate, perfectly, the gums. But

the color which we give to this piece, as we shall soon see, is not very durable; on the other hand, the pieces thus mounted always have a certain weight. These two reasons have given us the idea of imitating the gums on the bases having the mineral teeth.

In order to accomplish this, the piece being properly mounted, we take a sufficient quantity of the following composition given by Delabarre:

Porcelain paste,		3 i.
White sand,		3 ss.
Any oxydes we wish,		gr. 10.

We add a portion of mica, or calcined gypsum, to render the paste very fusible, and we reduce it to a very fine powder.

We apply a proper quantity of this paste either to imitate the gums or only to interdent their points; finally, we try the piece in order to correct the defects which may now be found to exist, then we put it to the fire. The presence of the gypsum in the paste renders it fusible at a much lower temperature than would be necessary to fuse the mineral or bake the mineral teeth unconnected with it; this paste agglutinates and solidifies the two parts of the piece; but if this composition has the form, it has not the color of the gums.

There are two means which can be employed for coloring it; one, composed and employed by Dubois-Chemant, consists in giving to the paste, of which we are speaking, the tint of the gums, by adding to it a certain quantity, for example, of precipitated purple of Cassius, or any other oxyde which has the same property; but, as we may with reason observe, the gums thus colored, want that transparency which life gives to all of the animal tissues. Fonzi, who first noticed this defect, believed he might avoid it by using jeweller's enamel, colored in melting, or afterwards painted. Pieces thus enamelled do not last long, and we have been obliged to abandon the use of them.

Those who employ this method, proceed thus: they cover the paste or biscuit which forms the gum, with an enamel composed of:

Petunsé,	. . .	2 drachms.
Oxyde of gold,	. . .	6 grains.
Kaoline,	. . .	6 grains.

They cover with the gums, including their apices, and then put it to the fire, but as it often happens that, from too intense heat, the vermilion color of the enamel turns pale, they take the oxyde of gold and beat it very fine, and add an equal part of turpentine and lavender. When the mixture is made, we pour a few drops of oil into it, which gives brilliancy to the color; then we paint with a brush that part of the piece which corresponds to the gum. We then place this piece well dried in an oven, and when it has become red, and thoroughly glazed, we take the muffle from the fire, and let it become cold, before we draw the teeth from it, as it might crack them if we expose them too suddenly to a lower temperature.

As this work is complicated, and as it is always difficult to calculate perfectly the results, we prefer, with reason, in a doubtful case, that is to say, before furnishing the front part of the plate with a substance for imitating the gums, particularly where there is a loss of the alveolar border, we prefer, we say, to make a true inlaying of hippopotamus, cut for this purpose, fixed to the plate by the same pivots or screw which unites the teeth to the latter, colored by one of the methods which we have given. We have even made this inlaying with blonde coral, that is, plain rose, but this substance increases the work without a sufficient compensation.

Mounting on Osseous Bases.

In our previous remarks upon the manner of making hippopotamus teeth, we have described the method of constructing with the same piece, teeth and their bases. But very often teeth are fixed separately upon them, and we ordinarily use for this purpose, natural or mineral teeth.

When we wish to mount human teeth upon a base, the seahorse, or any other osseous substance, cut in this manner; it having been well adjusted in the mouth, we place the

teeth below it and adjust them in their proper places, and maintain them there with a little wax for modelling; then, with a foret (drill) we perforate them with holes in their ends, in which we hold them with small pegs for the time being, upon this base. We then increase the size of the holes, and sometimes substitute for the pegs, central metallic pivots, or two pegs, either laterally or one before the other with rivets in both bases; sometimes, on the contrary, screws, either introduced through the teeth, and rivetted upon them, or, but more rarely, introduced and rivetted in the side of the teeth, but not crossing their base.

It is nearly in the same manner that we mount upon bases of this sort mineral teeth. We obtain the adjustment necessary by fixing them to wax, then we afterwards remove them with care. The impress marked by their form indicates the precise place where the holes destined to receive their pivots, should be pierced, and we rivet them upon the concave part of the base, using the precaution to make a counter-sink for the reception of the heads of the pivots to prevent wounding the soft parts with which they would come in contact.

In order that the teeth may not crack in rivetting, we place them alternately upon a piece of lead hollowed like a V, upon all the points of which they bear exactly; when this precaution is well taken, we can use the hammer, without endangering the piece. We admit here, that it acts with a pivot which does not cross; but in the contrary case, we apply the rivet of the tooth (human tooth) having its pivot previously attached upon a steel block maintained in a vice, then we rivet the other extremity upon the concave part of the base by means of another small steel anvil, whose point we hold upon the part that we wish to rivet, and upon which we strike with precaution.

The person who is rivetting, cannot hold the anvil, the hammer and the piece, he is obliged to have an assistant who shall hold this latter. We may, however, rivet directly alone with a pointed hammer, being careful not to injure the base, which is necessarily weaker in all the points where the teeth are received, than in the surrounding parts.

As the rivets made directly upon hippopotamus are never as solid as upon a metallic substance, we sometimes cut upon that part of the base which corresponds to the extremity of each pivot a groove intended for the reception of a very small band of platina, pierced with as many holes as there are pivots and upon which all are united in a countersink. We may, however, make the extremity of the pivot, a small target of platina or gold, countersunk in the base, and upon which we rivet equally with the surface, so that it may not project.

As these osseous bases are particularly appropriated to circumstances in which the alveolar border, having lost its thickness, has need to be replaced, we are often under the necessity of giving to that part of the base which surmounts the teeth, before a rose tint, similar to the color of the gums; but we tint them before the teeth are rivetted, so that we may remove the teeth which should not be colored. We employ different methods for obtaining this coloration. Laforgue advises simply to steep the piece a quarter of an hour in alum-water, and to put it in a decoction of cochineal; to remove it when the color is as required, but according to his own remarks, the saliva soon destroys the color.

Other dentists, perceiving the insufficiency of this procedure, place upon the parts which should be colored, a layer of hydrochloric acid, covered with water; then they place this piece in common water, and, after having well dyed it, they imitate the color of the gums by coloring it with a brush with many layers of cosmetic, employed as paint, under the name of *vinaigre rouge de maille*. This method is more sure than the preceding; the following one lasts equally as long. As all bony tissues contain an oily matter which opposes their impregnation by the coloring principle, at least until they have undergone a preparation which deprives them of it, we boil the piece in a lye of soda, in which we put a few drops of oil. From this, a very hard soapy water results; in a very short time we take it out and wet with a sharp acid, as the solution of tin with hydrochloric acid. Five or six minutes after we put it in an earthen vase, placed upon the fire, and containing $2\frac{1}{2}$ drachms of madder, $\frac{1}{2}$ drachm of kermes, 7 grains

of crushed cochineal, and a pint of fountain water. We boil it a quarter of an hour, agitating occasionally the liquid with a piece of wood. The piece withdrawn, has ordinarily a very deep color; we then plunge it in warm soapsuds, it then assumes a rose color much more permanent than by any method before described.*

Although pieces of denture whose bases and teeth are made of a single piece of hippopotamus, are daily becoming less common, a sufficient number are still made to render a description of the manner of coloring the bases, without affecting the teeth with the coloring matter, necessary. We first scour the piece in a lye, of which we shall speak when we come to speak of the manner of coloring the bases alone; then we dry it. We then steep the enamelled part of the piece several times in a vessel filled with melted wax, in such a manner that every part, which is not tinted, shall be covered. We then remove with a file, or any other analogous instrument, the parts which should be colored, being careful to free the festooned parts of the gum between the interstices of the teeth. We then rub the exposed parts in hydro-chlorate of tin, diluted in water, before plunging the entire piece in the colored bath, in a cold or lukewarm state, but not so warm as to melt the wax from the teeth which it covers. This method of coloring does not penetrate so deeply the parts to which it is applied as to make it as lasting as the preceding methods.

Might not the property of madder, which is given as a nutriment to animals, by coloring their bones red, be profitably employed by those who would wish to furnish pieces of bone for making basis of medium size? This kind of coloration, which is the result of a vital process, and not the effect of a simple impregnation of thin layers, might evidently accomplish the double end we wish to obtain; the experiment might cease when we had reason to suppose that a sufficient red tint had been imparted to the bones. However, this is

* Practitioners who employ this method, go so far as to say that bases thus tinted, are more durable than those which are not. This supposition seems to us gratuitous.

merely a suggestion which we make without attaching any very great importance to it.

As to the method which Delabarre* advises of obtaining the brilliancy of dentures composed of animal substances, which are always much too white at first, a method which consists of covering them with a brush, with an *alcoholic solution of resin* (he does not say which) colored with a little *cobalt of azure*, and which would be left to be destroyed by the saliva, we cannot conceive, in truth, how a man so judicious, could ever have had such an idea. What person could ever have the patience to keep many days in his mouth a coating as improper as it is offensive to the eye? Is it not more simple to make the piece undergo the preparation of which we have spoken, before they are mounted, and of coloring their bones as we shall show?

We should not omit to mention, in this place, that it is preferable to make the bases or mountings of hippopotamus of a single piece, though we sometimes find it necessary to unite two pieces of this substance by means of a bony peg, if the work is a continued series, or, by means of a metallic cross piece, if it is an interrupted; this would be, by far, more solid. The desire of giving much solidity to a denture of human teeth led some ancient practitioners to implant them in the base, that is to say, to sink into the hippopotamus, holes large enough to receive the roots of the teeth rounded with a file. Each tooth, thus forced in, is rendered still more solid by a peg passed from within outwardly. This kind of mounting has not the solidity which it seems to have at first glance, because the base, weakened by the enormous holes made in it, is liable to be broken, particularly at its anterior part which is very thin; for this reason, it is rarely employed at the present day. It is on this account, that bases of hippopotamus upon which gutters for the reception of the teeth are formed are abandoned.

Finally, we make mountings of bone and metal. To accomplish this, we adjust a plate of platina or gold upon the

* Work quoted, volume 1, p. 280.

mould, to the vacancy we wish to fill, then rivet upon it a very light piece of hippopotamus, fashioned in the form of the gums and colored accordingly, and supporting such teeth as may be required. Pieces constructed in this manner are light, and have great strength, because, however slight may be the thickness that we give to the false gums, the plate upon which they are placed, sustains them perfectly, while it permits the different means of attachment to be soldered to the metallic cuvette; but their adjustment should be perfect, else particles of alimentary matter would collect and exhale an unpleasant odor.

Mounting upon Mineral Bases.

If, in writing this work we have had no other end in view, than an exposition of our art, to the exclusion of everything else, in forming principles, we abstain from speaking of mineral bases, because, however well the bases themselves may be made, and with whatever care we may adjust the teeth, they are destined to sustain, the construction of these pieces is always difficult, and in every case difficult to maintain in the mouth. However, as many authors, such as Audibrant, Delabarre and Lefoulon, (the last writer,) in speaking of some details, we could not pass this subject in silence, in order to demonstrate such as have defects in their use, and are difficult in their construction, and to turn young practitioners from their use, or to regulate their use in some rare case, those, for example, when we are called upon to supply dentures for those who cannot bear the contact of metallic cuvettes, or for whom we might have reason to fear the buccal fluids would very soon destroy a base of hippopotamus.

But there are two things to be considered in these kinds of pieces. The construction of the bases themselves and the implantation of the teeth. That which relates to the former of these, might without doubt be better placed with the details connected with the fabrication of mineral teeth. But as this should be preceded by moulds of the parts for which it is destined, we think it best to speak of it after having treated of all which relates to this latter subject. In regard to these bases, the opinion of practitioners, who still abstain from ad-

vising the use of it, divide upon the question of knowing if it is possible to make them wholly of mineral substances, or if it is not better to make them in part of this latter, and in part of a metallic substance.

The great shoal of the partisans of mineral bases of small dimensions, as of complete bases, is in the shrinking of the paste which prevents that accuracy which is desirable, and which is comparative, compared particularly with that obtained from metallic or hippopotamus bases. We might in vain take the precaution of making the paste larger, according to some, a seventh, others an eighth and ninth, than it is to be, or if definitely fixing its dimensions after it has become dry, as Audibrant advises; the difficulty might be diminished, but not obviated.

In every case should we be fortunate enough, either by accident or otherwise, these bases can never be employed excepting for a continued series, the holes which would be obliged to be made in an interrupted series would give a fragility to it, which would render their use objectionable. Dubois-Chemant, himself, was so struck with this fragility, that he soon renounced these kind of pieces and preferred to make as many isolated pieces, as he had vacancies to fill, except when he held them united by means of a piece traversing the internal part of the dental arch.

But admitting that we may first make these bases so just that they will fall perpendicular upon the part which they should cover; secondly, give them lightness and besides a desirable solidity, how shall we furnish them with their teeth; if we wish to fix mineral teeth in the paste before the paste dries, they would abandon it always so much, that very prejudicial spaces would remain between them, and it would then require that the paste should be made of a more tender substance than the tooth. If we are willing to make in the paste, holes or implacements for teeth, we could never rivet the pivots upon which they should be mounted, without running the risk of breaking the piece.

Delabarre has thought he could avoid these different inconveniences in making his base, after the manner he had of

making the points of gums of which we have spoken, half of a metallic, and half of a mineral substance. In order to do this he mounted mineral teeth with pivots soldered upon a plate; then he furnished the spaces which existed between this and the teeth with a porcelain earth moistened, and submitted the piece to the action of fire. But, we repeat it, all the attempts that we have made in this respect have convinced us that it is extremely difficult, we might say impossible, to arrive at such results that the relations in which the constituent parts of these pieces have been placed are not destroyed by baking.

We conclude, then, that bases, and with greater reason, dentures of mineral paste, form pieces whose inconveniences are so manifest that we should always prefer those that we have previously described. Audibrant, by recommending the construction, always, of several of these pieces at once, *in order to be prepared for accidents* which might follow, pronounces the most formal condemnation of them; and Lefoulon, in admitting that of *six* that we may construct at the same time, we are not always sure that the fire will restore *one* perfect one, might as well have dispensed with the details that he has devoted to their fabrication.

Of the Different Methods of Fixing and Maintaining in the Mouth, Pieces of Artificial Denture.

Teeth *mounted* after the directions that we shall lay down, having occupied us thus far more with principles than details, will completely remedy the deformity resulting from the loss of those they are intended to replace; but dental prosthesis has not only for its object to deceive the eye, but also to subserve their functions. From thence the necessity of *maintaining* the different pieces of artificial denture so solidly fixed in the mouth that they may not follow all the movements of the jaws, but still more, resist the power which is habitually exerted upon the natural teeth, and, consequently, assist in mastication.

These methods of retention vary according to the circumstances to which they apply, and differ much from each other.

By reducing them to their proper physical worth, we find that they act in five principal manners; first, by that which we call *gomphosis*, or implantation as pivots; secondly, by *co-adaptation* as cuvettes, simply, juxta-placed; thirdly, by *compression*, as with crotchets; fourthly, by *attraction*, as ligatures; fifthly, by *reaction*, as springs. Let us examine each separately.

Pivots, or Implanted Tenons.

We have seen, in treating of the methods of mounting artificial teeth, how we furnish them with pivots; it now remains for us to show how the implantation of this pivot in the rivet is effected.

In most cases, the dental canal of the root is free, that is to say, deprived of the central ganglion, and it is only necessary to enlarge it in order for it to receive the pivot of the tooth, which should always be sufficiently large to resist without yielding the efforts of which it is the abutment. This is not, however, always the case, we are, sometimes, obliged to destroy this nervous organ, whose existence would not permit the introduction in the canal of the root of any body without occasioning the most acute pain; we then have recourse to one of the methods we have heretofore indicated, in order to destroy the pain of which the teeth are so frequently the seat.

Let us admit that the root is deprived of all sensibility, that it is healthy and properly filed; the first thing to be done is to enlarge the dental canal, either with a small steel or simple iron equaliser, which we lightly turn in the fingers, having care to use it slowly, and to often moisten it in order to prevent it from choking; or, better still, with a drill. As, in this case, the root, not having been softened by decay, has preserved all its hardness, we will have need to attack it with more force; on this occasion we employ the drill that we have already described, and which offers the necessary resistance. In the case where the root is decayed, the equaliser is most convenient; it should only be about one inch and a half in length, be cut with three sides, pointed and, particularly if of

steel, but slightly tempered, without this precaution it might break by the slightest movement, and occasion much pain to the patient.

The use of the drill requires some precautions; 1st, it is not necessary, at first, to employ any force, for it should penetrate progressively into the canal; 2ndly, we should be assured that it follows the direction of this latter, and does not pierce the root as far as its extremity. Understanding these principles, we commence by enlarging only the opening of the dental canal by means of an equaliser; then, the head of the patient being properly placed and maintained by the left arm which surrounds it, we present with this hand, to the freed orifice of the canal, the drill which we have had care to roll upon the cord of the bow; then we fix it there by the aid of a small metallic shank, (rose drill,) mounted upon a handle upon one side, but provided at its other extremity with a cavity intended to receive the rounded part of the stem of the drill; then, finally, with the right hand, we make the bow act, having the precaution, as we have said, to remove it, from to time, in order to moisten it. We enlarge this first hole with a larger equaliser, and when we judge that its size is sufficient, and approaches the extremity of the root, we clean and completely dry it with a little cotton in which we envelope a small metallic probe.*

This being made, we try the depth of the hole in order to know what length we should give to the pivot; we cut this latter, and we file it until it is of the size of the drill employed for piercing the root. But what form is it necessary to give to it, and how shall we fix it? Most practitioners, those, particularly, who, with equal worth, prefer a simple to a complicated method of procedure, are satisfied to give to the pivot a cylindrical rather than a pyramidal form, to make some small notches in it for wrapping it with silk or thread, put the tooth

* It is necessary to know that it is not always right to direct the perforating instrument in the direction of the dental canal; for example, when the incisores have many roots, and when we pass between them, or when the root deviates from its ordinary direction.

in place, to attest its solidity by slight lateral movements, and to press strongly upon it with the fingers, or with plate nippers, or, finally, with the aid of a small piece of wood, having a small groove for the reception of the cutting edge of the tooth, upon which we strike lightly.

We may, still better, consolidate this tooth by putting upon the rivet of the pivot, when it is crossways, a small punch upon which we strike lightly, but having care to apply it upon the pivot itself, and not upon the tooth, which the slightest shock, in this place, particularly, might break. Finally, we accomplish the end very well, sometimes, by striking simply upon the cutting edge of the tooth after having placed a slight layer of linen or paper upon it.

But these methods of implanting a pivot in a root, have appeared too simple for some practitioners, eager for innovations. From thence, the *seal pivot* of Fauchard, the *screw pivot* of Bourdet, the *clacking tenon* of Maggiolo, the *subérique pivot*, furnished with cork by Ricci, the *tenon à antennes*, the perforated tenon, &c. &c.

These different pivots or tenons may have advantages, under certain circumstances, but we say, that generally, they are not as good as the simple pivot. We do not make an exception in favor of tenons or screw pivots, because, if this is a good method for fixing a pivot in the artificial tooth, it might not be for the root; in effect, if it is possible to stop, when we please, in screwing the pivot in a tooth, we have not the same advantage in screwing it in a root; it is then very difficult, if not to say impossible, to have it fall in such a manner that the exterior face of the false tooth, shall harmonise with the circle and the festoons of the gum.

We may even remark, that practitioners, who have advised the use of screw pivots for attaching teeth to the roots have not thought, or dreamed of the impossibility of joining the two parts between which they have left no space, and that the gum might again cover the tooth. It is necessary in order, in using this kind of pivot, that the root should be filed square, which should not be. We do not, certainly speak here of teeth already mounted upon pivot; but we conceive, very

readily, that there might be a method of mounting a *screw* tooth upon a root with a screw; a pivot might be primitively screwed upon this latter, and the tooth so arranged, that it might receive the extending part of the pivot, by pure implantation, as persons daily do who wear pivot teeth, the holes of which are enlarged, and which they themselves put in place.

Feeling the importance of this observation, and wishing, in the meantime, to profit by screw pivots, thinking they were most advantageous, in regard to solidity, in roots, some practitioners fixed with a screw, in the hole made in the root, a gold cylinder, of course hollowed, and screw shaped in its entire length, within and without; then they place a screw cylinder in the artificial tooth, of a diameter equal to that in the root. When the two tubes are arranged, they construct a screw without a head, of a thickness proportioned to the diameters of the cylinders, put the tooth in place, introduce, into the cylinder which traverses it, the screw which they turn in order to fix it in the root, and the tooth superplaced, upon the root has a stability, which we seek in vain to obtain from any other procedure.*

Certainly, if this method was as easy to execute as to describe, it would merit the preference of all others; but independent of time and expense, which are small matters in comparison to other difficulties which have to be overcome, as the partisans of this method acknowledge, in order to give to the cylinder of the tooth and to that of the root the same direction and to place them exactly, vis-à-vis, the one to the other; then, in order that the part of the pivot which should be received in the cylinder of the tooth should be sufficiently easy, in order to enter the root in proportion as we screw it into the root, and so exact that it might maintain the tooth perfectly immovable. We think that if one tooth, properly placed in this manner, has the merit of overcoming a great

* Maury has wrongfully taken the credit of this to himself; Laforgue (vol. ii, p. 63) describes it at length and gives the honor of it to Dumergue, Talma and Tompson.

difficulty, it has not, in the end, sufficient advantages to compensate for the unfavorable chances of success that it offers.

It is the same with the pivot called clacking, by Maggiolo, which Delabarre recommends where the other pivots have already, by their use, considerably enlarged the hole of the root destined to receive them, but whose construction, certainly an ingenious one, has led some persons,* who have believed that the question of an artificial piece consists in the facility with which it can be removed and replaced. In order to form an exact idea of this kind of a fixture, we must examine the clasps of a lady's bracelet. It is a stem to which another is attached, forming a spring, and furnished with a projection intended to be received in a hollow-joint, the thickness of the cylinder which is to fill the root.

When we perfectly understand the manner in which this pivot is attached, we perceive that, independent of the inconvenience the practitioner experiences, in requiring so much of the root, it has still more, this, that if, at the moment when we make it penetrate the cylinder of support, the two stems which form it touch by the pressure that they exert, they cease to make it at the moment when the projection of the spring penetrates in the joint of the cylinder, because, in introducing the spring, it is made to traverse a distance equal to the depth of the hollow joint in the walls of the tube or cylinder contained in the support. These two stems, of necessity, leave a space between them, immediately at the point where the false tooth and root meet, in which the buccal fluids and alimentary particles lodge.

Then, if we have to select between this clacking pivot and the antennes, which is merely a pivot cut lengthwise, into two parts, making a catch upon the walls of the tube of the root, we would prefer this latter. It has, first, this immense advantage over the latter, that the orifice of the hole is completely filled by the pivot; it is, besides, of a less complicated structure, and, consequently, is more certain in its results.

* The author of the word *TOOTH*, in the *Dictionnaire des Sciences Medicales*, (vol. viii, p. 390,) declares he knows persons who wear teeth thus mounted, and praise them exceedingly.

As to the precaution that Delabarre takes of fastening the pivot by a transverse peg, introduced between the gum and the root by an opening made in this latter by means of a very delicate drill; it is more specious than rational. In effect, one of two things, either the root forms a projection, without the alveolus is sufficiently large, in order to render the implantation of the peg profitable, but then the place where the false tooth and its support would meet is visible; or the root is cut so close that it cannot be perceived, but then the drill is applied too near the point of the root upon which the false tooth should bear, so that the exterior wall of the hole, through which the peg should pass, could not offer a sufficient thickness. This method, as we easily perceive, might be applicable only to wood pivots, or would offer great difficulties if they were metallic.

It is not only upon the form of the pivot that practitioners have devoted themselves, but still more upon its apparel. Thus, for simple objects, as cotton, thread, hemp, or silk, of which we have spoken, we have proposed to substitute amianthus, the bark of birch, and different metallic substances, as lead, gold and platina reduced to leaves sufficiently thin to be wrapped upon a pivot. These latter substances are often employed, because they do not putrify, and exhale an offensive odor; but not being susceptible of swelling by moisture, they do not always perfectly adapt themselves.

Unfortunately, one is not always so happy as to have to deal with healthy roots, or where the canal has not been too deeply destroyed by decay. In this latter case, it is necessary, after having carefully removed from the root, all the soft parts which can be detached from it, not about the pivot, but to furnish the cavity of the root, with two light pieces of soft wood, cut in the form of a V, so thin that they may be rolled round the pivot which the humidity causes to swell, and to place this latter in such a manner that it enters with force. These small wedges of wood, have another advantage of making the tooth recede or advance according as we place them, before or behind the pivot. We sometimes employ, in similar cases, either a kind of sealing or cramping, made with the fusible

metal of Darcet, with which we fill the cavity of the tooth, in order to plunge the pivot in, during its fusion, this is particularly appreciable to mineral teeth, whose pivot we heat; or a small funnel of platina.

The care that we take to implant solidly pivot teeth, proves that it is merely a prejudice of opinion that induces some to remove the teeth, in order to clean them. When they are intimately united to the roots, so that we might in vain endeavor to pass a thread between them, no putrid matter could be introduced there. Every derangement is then only favorable to the wearing of the teeth, or rather of the root, of which the pivot would always, each time that we remove it, drag with it, however particular we may be, some particle of it.

It then necessarily results from it, that it is a false belief, which would deprive us of the power of testing, by pivots, the solidity of pieces attached by cuvettes or ligatures, of which we shall soon treat, or sustains upon metallic bases, under this pretext, that the need of cleansing the pieces, require that they should be frequently removed; to do this, the pivots must be loose. When a piece is well made, and particularly well adjusted, it should be rarely removed. The advice that some practitioners give, amongst others Saveau,* of often removing them, *even every day*, in order to clean them, is an error which cannot be too strongly condemned.

We remark, then, that when pivots, employed as accessories to other methods of fixing pieces, for example, soldered to parts of plates which rest upon the alveolar border, have to support the efforts of these pieces, whose abutment they very often become, we experience the greatest difficulty in establishing an exact relation between them and their holes of support, as in the case of an isolated tooth, it is always prudent not to abuse the resource that offers here, and to manage the holes in order to make them useful at a later period.

As to the method of fitting pivots to the internal or concave part of plates, it is simple. We commence by piercing the roots; then having heated the plate, we cover it with

* Nouvelle Hygiene de la Bouche, 7 vol. 18 c. 1843, p. 310.

wax, for the purpose of applying it on the place it should occupy in the mouth, and upon which we apply it to obtain a relief mould, corresponding with each hole. This impression taken, we remove the plate, perforate it at the 'places marked ; then replace it in order to pass the pivot from the convex to the concave surface of the plate, which has been previously adjusted in the root ; but this pivot should fit tightly in the hole, so that it may be removed with it, without altering the position it had in the root. If the hole is too large, a light blow of the hammer upon the plate, or upon the head of the pivot would soon reduce the one or increase the thickness of the other and establish the correct relationship between them. This end attained, we solder on the convex part of the cuvette, that we may file or saw off the superfluous part. It is not well to attach many pivots at once, because in securing one, we may derange the other. It is, therefore, better to adjust and solder them successively.

In a piece of a continued series, of a certain extent, we can place as many as six pivots upon the plate ; this will dispense with any other means of attachment, and would be particularly applicable in those cases, where, from the absence of lateral teeth, crotchets cannot be used ; also, in cases where the lower teeth strike the upper in such a manner as to preclude the use of these latter attachments.

If the different means which we have described, have succeeded in maintaining false teeth for a long time, implanted upon doubtful roots, it is no less, always, very imprudent to place them on roots where decay has destroyed nearly the whole of the dental canal. It is useless, as some have imprudently advised, to employ perforated pivots for the escape of pus ; it might be so suddenly arrested as to occasion very unpleasant fluxions, and even of nervous affections which the extraction of the tooth alone would not arrest. The cause which induces the formation of pus should be combatted. Many young practitioners, for want of attention, commit this error, and thus induce those with whom pivot teeth would answer a better purpose than any other, to forego their use.

Prudence and skill, however, does not always prevent these

accidents, for they may often be occasioned by a pivot too long, which may touch the remaining portion of the dental nerve, which we may have neglected to destroy, or by its fracture in the cavity of the tooth. In the first case, the whole of the artificial tooth will have to be removed; in the second, the pivot will have to be extracted. It is, generally, easy to fill the first indications; not so with the second, at least, not without breaking the pivot in the cavity of the root. It must then be removed, either by diminishing the pivot or by enlarging the canal.

If it breaks off high up in the root, what is to be done? Should we attempt extraction, as some authors advise, *with pliers fitted and hollowed lengthwise, forming indented gutters?* But then these pincers would have to be very small to be introduced into the root, and, besides, the root would be very much weakened near its upper extremity. It would be better, perhaps, to pierce the root with a small drill in such a way as to reach the upper part of the pivot, then, a steel wire, bent at the end, might be introduced, and the pivot extracted; but this would, certainly, always be to the detriment of the internal part of the root.

Mièl has invented a very ingenious instrument for the extraction of broken pivots and drills. It is a small trephan, with a tube in the centre for the broken pivot, and whose walls form two branches, and are susceptible of elongation and contraction. Moved upon a handle, or perforator for roots, it destroys every thing surrounding the pivot, and permits us to seize it. The small steel tube, terminated by saw teeth, forms a miniature drill, and the one to which Maury says he had recourse in a case like those just described, are nothing more than the trephan of Mièl.

All of these methods, of which the two latter are not applicable to cases where the pivot cannot be implanted in a right line, have the inconvenience common to hollowing the root; thus, we prefer to make a screw pivot, and form at its expense a new hole. In this way, either the pivot thus liberated falls out and leaves the hole ready for the reception of a new one, or it is hollowed in the direction of its length to re-

ceive another of less size. But we can conceive, how, during this operation, it is necessary to be in the habit of using the drill, and how, consequently, we should always have present to the mind, those principles which we have established for its use, and the forgetfulness of which might be very prejudicial.

Finally, we can place, successively by the side of each other, six mineral teeth united together. In order to do this, it is necessary that the pivot of each should enter with much ease the dental canal which should receive it. When the teeth are adjusted and fixed in the mouth, we take the impression of the whole with wax, that they may all come out and remain in it. If one or more of these teeth should not come, it may, afterwards, be removed and placed in its proper place. We then pour upon it a sufficient quantity of plaster to maintain them solidly united, then leave it to harden. The wax being removed, we fix a metallic band upon the posterior face of the teeth; we fasten it to them with iron wire, and solder it upon the plaster model.

We shall not terminate that which relates to pivot teeth without speaking of those which are maintained with crotchets or ligatures. When we employ crotchets for the purpose, they are soldered to the plate upon which the tooth is necessarily mounted. The ancient dentists arranged these crotchets in such a manner that the central point of the quarter of the circle which they form, corresponded to the middle of the side of the plate to which they were united, enveloping the tooth as much before as behind; they called these tenons with grooves. But for this kind of crotchet we have substituted others of which we shall soon speak. Ligatures used with pivots form an expeditious method of securing and giving great solidity to a tooth; but they have inconveniences which renders their use very objectionable as we shall soon show.

Pieces held by Simple Co-adaptation.

It is among pieces maintained in the mouth by *co-adaptation*, that we place those sustained by juxta-position, aided, for the lower jaw, by their weight, and by points of contact

with the neighboring parts, for those of the upper. It is easy to see that such pieces which receive in practice, but improperly, the name of *simple* pieces, since they may be very complicated, or *flying* pieces, since they do not move, may be *more particularly* applied only to the inferior jaw, because, having no attachments upon the sides, and not being retained by any mechanical means, they can be kept in place only in a way which precludes any movement. Their mode of application comes under the principle of co-adaptation, these pieces, ordinarily, have a large base, hollowed for the reception of the alveolar border, upon which they are intended to be raised very high, and which they immediately encase.

These pieces are frequently used in England; we may even maintain them nearly as well in the upper as in the lower jaw, in obtaining, by the extent of the cuvettes for the first, that which we accomplish by their own weight for the second. Experience has even proven that a single piece can be maintained better than two; in this latter case, it is true, it would be safer to employ springs. Gardette, an able dentist of Philadelphia, says Laforge, was one of these practitioners who, in his time, succeeded the best in the kind of work of which we are now speaking; but it is as well to observe, that the pieces which he constructed required, in order to attain the precision of adjustment that he gave to them, so much time, that the price of them was, necessarily, very high. This observation might be just at the time when Laforge wrote; but if at the present time we employ a few of these pieces, it is not because they require too much time, but because those which are maintained in the ordinary way, are not valued.

Let that be as it may, these pieces rest sometimes upon the jaws entirely deprived of teeth; the contact of the lips and jaws which press upon their exterior border, slightly rounded, in the form of a hood, greatly aid in maintaining them; sometimes upon the jaws which still have some teeth; these latter, then, serve to give them solidity, either because they lean upon them on one of their sides, or because they are received in the openings constructed for them in the base of the piece.

In the first case, that is to say, when we have to construct a

piece without any attachment upon the jaw, (the inferior, certainly,) entirely unfurnished, we should then, as we say, besides the regularity with which its base receives the alveolar border, depend equally upon its own weight. This base is ordinarily a thick cuvette of platina, the anterior contour of which we enamel with a color like the gums, before fixing the teeth upon it. But bases of the sea-horse are greatly preferable, because, by its nature, this substance unites itself more intimately to the gums than metallic cuvettes. These are the pieces which it would not be well to traverse with rivetted pivots, at least those made of wood. In the second case, that is when the jaw has some teeth still remaining, we arrange them, so that an exact relation will exist between them and the piece; this can only be done by taking a model of the relations with precision.

Does it necessarily follow because compelled to make these pieces heavier than the ones which are maintained by direct means of attachment, that they should have great bulk? No, for this bulk would exert a pressure upon the jaw, which, if it were not painful, would, nevertheless, insensibly affect the alveolar border. We cannot then condemn too severely the opinion of Delabarre, who thinks that we should give to these pieces a base *composed of a mass of platina encrusted with the graver*. This work, would not only be difficult, but when we know how much trouble we have, to make a correct base of hippopotamus, which we are obliged to carve upon a relief mould, we see what obstacles we have to overcome, in order to thus employ a metal as hard as platina. The greatest inconvenience, we repeat, would be in the pressure of the piece upon the jaw. We then think that this work would be very difficult to execute, we would advise it never to be undertaken.

Of Crotchets.

The attachment of teeth in the mouth, or rather, of artificial pieces, offers, as we see, particularly in regard to solidity an invaluable resource to dental prosthesis. Thus this

method of attachment, whose advantages, however, it is not necessary to exaggerate, since they are often purchased by great inconveniences, might be, in the generality of cases, preferable to all others, if we never lost but the crowns of teeth; if the roots always held them solidly implanted in the alveoli; if these roots were always preserved perfect; finally, if we had always to place them upon a piece of small extent, because the larger pieces, would send all of its shocks to its extremities, which would necessarily render it less solid and would cause it to act laterally.

These favorable circumstances are, unfortunately, as we have already said, far from being met with as often as we might desire; we are then frequently obliged to have recourse to other methods.

Amongst these methods, the most useful, after pivots, are crotchets. We designate under this name branches of platina, or better of gold, round or half round; but most ordinarily, plates, whose bent extremities serve to fix to solid teeth, artificial pieces, to which they are soldered or rivetted. Their mechanism is so simple, and their use so frequent at the present day, that one is disposed to believe, that their invention can be traced to the most remote period of dental surgery. However, this is not so, for not only the writings of Fauchard and Bourdet make no mention of it, but there is nothing said of it in the works printed in the first years of this century; we are then led to believe, that they are the inventions of dentists of our epoch.

Crotchets act entirely upon the principle of *compression*; that is to say, they should bind the teeth upon which they are placed, but in such a way, that they will not pull them in any direction: without this precaution, acting by *attraction*, or in the manner of ligatures, they would glide under the gums, separate the tooth from them, loosen the supporting teeth, and cause their loss. They should then unite themselves to these teeth in such a manner, as to fit perfectly upon them, for if they exerted any friction, they would of necessity, wear only the teeth they surrounded, and, whatever their size, they would change their supporting angles. From thence, the ne-

cessity of never fixing them, in regard to their length, without being well assured that they fit exactly upon the teeth for which they are intended.

We conceive, then, that their development should correspond to the volume and position of the tooth, around which they should be passed. If this tooth is a large molar, they should necessarily be larger and greater, because this tooth is larger than those in the front part of the mouth, and not being seen, we should give them a development nearly equal to a complete circle ; whilst, for the anterior teeth, we give, in order to render them less apparent, the least possible extent ; but, it is always necessary, that they should fall slightly upon the anterior part of the supporting tooth. To say, in effect with Maury,* that we are content to give them, *ordinarily*, a *half circle*, would convey the idea that we were unable to explain their physical manner of action.

In order to render that part of the crotchets which borders the dental interstices less apparent in front, we should cut it lightly in festoons, at the expense of those of its edges which touch the gum, particularly in the superior jaw, where the least elevation of the lip, would expose the neck of the tooth in front.

But from this necessity of rendering the crotchets as slightly apparent as possible, it no less results, that Maury erred, as we have said, by asserting that we should, in a general manner, give them the form of a half circle : Lefoulon† is still less correct in saying, that the form of the crotchets *varies, necessarily, according to the form and disposition of the gums themselves*. Their conformation should, before every thing, as we know, and as the end for which they were employed indicates, be dictated by the volume, configuration and position of the supports which they should embrace. In this matter, as in many others, the useful should be valued in preference to the agreeable ; but we should certainly always seek to reconcile them.

When, by the shrinking of the gums, a portion of the roots of the supports is exposed, it often happens, that the crotchets

* Work quoted, p. 356. † Work quoted, p. 380.

in proportion to this shrinking, embraces a part smaller than that for which it was primitively intended; they are then obliged to close very much upon themselves; but if they are not sufficiently elastic, they will not be straight enough for this part. In this case, it would be necessary to tighten the crotchets, or surround with a non-putrifying thread, that part of the tooth upon which they are accidentally placed, and to furnish them, themselves, with the same covering. This variation does not destroy the great usefulness of this excellent method of fixation; they have particularly this great advantage, that of permitting the pieces to which they are attached to be removed and replaced at pleasure; they can be cleaned when we think useful, and thus prevent the accumulation of alimentary particles, whose decomposition in the mouth is always injurious.

The authors of the word **TOOTH**, of the *Dictionary of Practical Medical Studies*,* have committed an error in pretending *that we use teeth for crotchets, when no part of the roots remain susceptible of being perforated, in order to serve for a base for a pivot tooth.* It suffices, to read that which we say of the conditions in which pivots should be used, in order to be perfectly convinced to the contrary.

But if crotchets may be employed in many cases where the roots exist, even in a good state, no artificial denture, whatever may be its form and the substance employed for its construction, can be maintained by crotchets, only when natural teeth, or portions of teeth exist, capable of giving a sufficient support, and these agents apply as well to pieces themselves, as to plates or bases, which serve as montuses.

For example, do we wish to fix crotchets to a base of hippopotamus? the method is simple if we believe the most of elementary authors. According to them, it would consist,

* The gentlemen it is true, know little of dental prosthesis, for a little farther on, they say: *We sometimes prefer to ivory which changes, metallic plates.* If by *ivory* they mean the true tooth of the elephant, they have erred, for more than fifty years it was renounced; if, on the contrary, they wish to say the tooth of the sea-horse, they err still more, because we do not sometimes, but *most ordinarily*, prefer metallic plates to it.

simply in making a screw at the extremity of a gold wire of the thickness judged necessary from the force of the piece and the nature of the support; they then implant this screw, flatten the wire with a hammer, and give to it the proper form. But those who know how difficult it is to give this form to the crotchets, even by trying them many times upon the mould, necessarily find this method defective. We first fix not one, but two screw pegs in the hippopotamus, and, the crotchet being properly formed, we then pierce two holes, in which we introduce the two pegs with their heads countersunk.

If the piece is mounted upon a metallic base, whatever may be the nature of the teeth, which are only fixed there afterwards (since the construction of a plate and its furnishment with crotchets, are only, so to speak, the two periods for the same operation,) we think best to solder the crotchets. In order to do that, we unite them, temporarily, either by surrounding them with an iron wire, or with plaster, which is preferable, particularly when we have many solderings to make. In this latter case, the plate and the crotchets being placed in relation upon the plaster mould, we take from the softened wax which we apply upon the whole, and remove with it the plate and the crotchets which remain in the same relations; then we pour some diluted plaster upon the concave face of the plate, we leave it to cool, and then remove the wax with much case, in order to expose the metal, so that its fusion shall not injure the soldering preparation.

If the plate is gold or platina, we solder after the method that we have hitherto given, having care that the crotchets are always of eighteen carat gold, the only standard in which this metal is capable of acquiring the necessary elasticity; an elasticity which we particularly obtain by hammering them upon the elongated prolongation of a small anvil.

But if the plate be of platina and the crotchet is of the same also, we unite them with soldering twenty carats fine, but not with the ordinary soldering which, not penetrating sufficiently the two metals, does not give to the whole a necessary solidity. It is always better, at first, to solder the crotchets only in part, so as to be able to adjust them with more facility, and to open

or close them at pleasure. If we solder them wholly, we might often be obliged to separate them from the plate.

Crotchets may accidentally break, and Delabarre thinks, that in most cases, it is better then to rivet than to solder them to plates; that which, to his eyes might have the advantage of giving to them more elasticity, because he would not be obliged to submit them to the fire in order to solder them. He sometimes advises us, in order to accomplish this, to make crotchets of wire sufficiently strong to admit holes intended to receive the pegs; sometimes, on the contrary, he solders the crochet to a small solid plate, which he rivets upon the principal mouture. We are far from entertaining this opinion, first, because the elasticity lost by the fire is easily recovered by the percussion of the crochet, even at the time when it is mounted; then because one or many rivets never possess the solidity that soldering gives to it, and it would always be very difficult to rivet the crotchets very thin. As to the plate, by the interposition of which, he wishes to make the rivettings, it should be double as he says, and, then it increases very much the thickness of the cuvette, or if it is *thin*, it does not possess the necessary solidity.

We have only considered crotchets in their simple form, but the intelligent dentist would vary this form, and appropriate it to the multiplicity of different cases, which are constantly presented to his notice. It is thus that when the teeth which form the two sides of the vacancy which the piece should fill do not appear solid enough to resist the compression of the crotchets, he gives to the branch which carries them a sufficient length in order to permit it to extend behind many teeth, until it reaches the one which he judges fit for a support, by weakening the effects of its elasticity by successively soldering the one to the other demi-clasps, and forming in the places of their union, small spurs which, insinuating themselves in the inter-dental spaces, prevent all shaking. It is to this kind of crotchets that Maury* improperly gives the name of springs, as we may see in the following phrase: "Springs differ from

* Work quoted, p. 356.

crotchets, first because they can only be made with sixteen or eighteen carat gold, secondly because they are much longer and are attached to teeth very distant from the artificial piece."

If the teeth behind which these demi-clasps should pass were loose, we might give them more height, so that they would offer demi-circular cells intended for sustaining these teeth; we might, even, in order to give more solidity to the support that they would offer to them, pierce them with many holes through which ligatures should pass which would join before. This method is the natural tendency of the treatment appropriate for loose teeth, which we have noticed under a therapeutic and pathological view, in the first part of our work.

The disposition of crotchets in half-clasps, successively soldered the one to the other, unites the advantages of the spring or *elastic compressor*, properly called, to that of the crotchet which is often only an *inert compressor*; this kind of crotchet is very commonly employed at the present day, because to the advantage that we have mentioned, it joins still more one not less important, that of hiding the method of attachment, which it carries back as far as possible.

The crotchets being fixed to the piece which they are intended to keep in place, of which they, from that time form a part, and to which they should, we repeat it, be soldered before the application of the teeth, it acts by passing round those which remain in the mouth, and which are intended to receive them. This part of the adjustment of a piece sometimes offers difficulties. When these difficulties are met with, the young practitioner is much more embarrassed, as authors who have hitherto written upon our art have made no mention of it.

But when teeth around which the crotchets should be fixed leave at the extremity of their crowns a sufficient space between them and the neighboring tooth, nothing is easier than to pass these crotchets, bent in the direction and in the degree wished, around the tooth, by introducing them, vertically, through the dental interstices. But if this space is too nar-

row, we diminish the thickness of the crotchet either with the file, or, which is preferable, the hammer, which preserves a great portion of its force, provided, however, that we anneal it, without which it would easily break. When any space exists towards the crown, we have not, as upon the plaster mould, the advantage of opening a way for the pressure; we pass one of the crotchets by presenting it by its extremity to the triangular space left between all the teeth about their necks, but if the piece is small, the extremity does not present itself in the direction necessary for its introduction.

What is to be done in this case? One of two things; either to open a passage by the file at the expense of one of the two teeth between which we wish to penetrate, particularly if one of them is decayed; we rectify the crotchets by effacing their curvature, then introduce them both at the same time, in order to bend them upon the teeth, once passed. But as they possess such thickness sometimes, that they are not easy to bend in that state, without employing a pressure which would be painful, we have sought another method, and we believe we have found it by mounting one of the crotchets upon a rivetted pivot forming a hinge, absolutely as an ear-ring. By this method, the piece is presented within the direction proper for one of the crotchets, and, once in place, the other crotchet, which is lowered behind, is directed in the space which it should occupy, and develops itself upon the internal, and slightly upon the anterior part of the tooth, where it is fixed by a light pressure, exerted by means of a pair of nippers.

In order to prepare cases where the vacancy is extremely narrow, we are often obliged to cut away a small portion of the sides of the teeth, with a file, to make room for the thickness of the crotchet, particularly when we employ mineral teeth; this might be done upon natural teeth, but it would evidently render them less durable, for we would be compelled to remove a portion of the enamel.

Finally, if we have to envelope with a crotchet the two or three last molares, which have no space between them, or are not decayed, so as to require filing, we make that which we call a crotchet with *pliers*. This crotchet is made differently from

those we ordinarily construct, we think proper to describe the manner we make it. We form, as for an ordinary crotchet upon the mould, a clasp surrounding the first large molar by its three faces, that which corresponds to the vacancy, fronting the tooth; we then adjust upon the second large molar, two other half-clasps which we solder to the extremities of the first, and the same for the wisdom tooth, having care that the extremities of the crotchets which belong upon the posterior part of the tooth should embrace it exactly. We perceive that this kind of crotchet is no other than the double of that which we have said wound behind the teeth, in order to fix it to one other elongated by that which embraces the sides of the teeth.

Of Ligatures.

The ancients maintained artificial pieces in place by means of ligatures; but the moderns, struck with the disadvantage that these agents possess by so easily breaking, and not permitting the rapid displacement and replacement of the piece, have very much diminished the use of them, without removing them altogether. Thus we employ them at the present day only when it is impossible or difficult to have recourse to other methods of fixation.

Ligatures are, to speak properly, only cords or bands which we procure from the vegetable, animal or mineral kingdom; from thence their ancient distinction into *soft* and *stiff* ligatures. The first are threads of hemp and linen, or the threads of silk known under the names of *twist of raw silk*, *Chinese root*, *Florence hair*; the second are wires of platina or fine gold. They are vertical, lateral, or compressive, and are even susceptible of combining with pivots and crotchets; but they nearly always act by an oblique and even sometimes horizontal effect; those which act in a direction inclining perpendicularly have necessarily more force.

Most frequently, we can maintain an artificial piece by ligatures only by piercing the holes in such a manner that the thread shall incline towards the gums. The position and

direction of these holes vary according to the kind of work upon which we apply them; but it is necessary, always, that their lateral orifices are placed a little beyond the level of the gums; if too far out without, they would be visible; if too far within, they would loosen the teeth which they surround; thus, the model is rarely a fit guide to the determination of the precise point; with a crayon or small burin that we should mark it upon the piece fixed in the mouth itself. We will examine each in particular, in order to appreciate the real or comparative value.

1st. *Hemp* and *linen*, employed under the form of twist-thread, such as we employ for ordinary sewing, are resisting; but, swelling very much by humidity, they may exert upon the teeth a very great traction. Employed under the form of a flat-thread, or small fillets, they are less subject to shorten by the humidity, but are more readily affected by the saliva; they are not used by modern practitioners,* and we only find upon pieces worn by persons who inhabit parts of the country distant from large cities or residences of dentists, and who are compelled, by necessity, to make use of them.

We have recently sought to use for ligatures, the filaments that we extract from the leaves of many kinds of aloes, and whose utility we have been able to test for a number of objects, since our conquest of Africa. We have many times tried this vegetable linen, and acknowledge that, although, it is sufficiently strong, it, nevertheless, changes so readily, and, consequently, merits no preference over the ligature we shall now treat of.

2nd. *Silk*, ordinarily,† can only be employed for ligatures, after it has been arranged in thread. Thus twisted, it is very solid, and its use is so frequent, because it changes much less readily than the three preceding substances; but it has,

* Fauchard advises them, however, very often in preference to silk, of which he does not know, it is true, our different methods of preparation. See pp. 218 and 219, of vol. ii, of his work.

† Silk, every one knows, is an animal product furnished by the envelope in which the silk worm shuts itself up in order to transform itself into a chrysalis.

like them, the inconvenience of swelling by humidity, and then, in shortening, of moulting, ascending easily towards the gums, in order to reach the narrowest part of the teeth upon which it is fixed, and thus wears them out as quickly, at the same time that it pulls them in a different direction, and loosens them. In order to give to the silk thread more solidity, we impregnate it with a resinous gum, which not only renders it less affected by the saliva, and thus prevents the odor that its decomposition produces, but it also prevents its shrinking so easily; it is this that we improperly call the Chinese root, which we employ very frequently.

3rd. *Florence hair* is only a species of silk taken at the time when the worm which produces it is ready to begin to spin, and which we make undergo a preparation.* It also resembles small gut threads, softens and becomes flexible, like them, in warm water. Of all the soft ligatures we make more frequent use of this for fixing pieces of artificial denture. The preference that we give to it is owing, particularly, to its pearl and transparent color, which renders it nearly imperceptible; it deteriorates very slowly, and warrants us, consequent freedom from the unpleasant odor which the decomposition of other substances produces; not unravelling, it does not relax; finally, being nearly impermeable, it does not keep up about the neck of the tooth stagnant humidity capable, in time, of decomposing them. As humidity makes it elongate, we should preserve it in water, or dip it in it a half an hour at least before employing it.

Whatever may be the substance which forms the soft ligatures, we confine them by knots which we form upon their sides, and always, as much as possible, between and behind

* In order to obtain this thread, we select the largest and most transparent silk worm amongst those which are ready to spin, and we plunge them in strong white vinegar. We remove them after twenty-four hours, and seek in its body for the gland, or sac, which contains the silk-matter; we draw this matter out, which is gelatinous, and we lengthen it out from twelve to fourteen inches, with much care, so as to form a thread as round and united as possible. This thread, notwithstanding its fineness, is equal in strength to ten or twelve hairs.

the teeth, so that they shall not be seen nor wound the lips. In order to do this, we cross the thread twice in the same loop, draw it moderately, and again cross it, but only once, and to the reverse, in order to form a knot which we sometimes cover with a third crossing. This being accomplished, we cut the thread close with curved scissors.

4th. *Metallic ligatures*, whose use in our art, runs back very far, seems at first much superior to all those of which we have spoken, because they are effectively more solid, and because they are easily applied; but if they maintain perfectly artificial teeth in the first moments of their application, they relax; rubbing them upon the necks of the teeth, wearing and rendering them painful, and insensibly cut them. Let us add to that, that they are more difficult to conceal, and we will be forced to acknowledge that their advantages scarcely compensate for their inconveniences.

We have seen, in speaking of metals, that gold and platina, intended to make ligatures should be of the highest standard, because in this state they preserve all the desirable malleability. In order to fasten these metallic ligatures, we employ long, narrow and strong beaked nippers, with which we draw out the posterior end, which we pass between the teeth, we then turn it with the other thread towards the lateral parts, but observing that that which passes before the tooth should cross under that which passes behind for the superior jaw, and under for the inferior. This kind of ligature is not as good as the flattened ligature which some employ, as the latter produce less friction. Some practitioners surround the tooth with silk before they apply the metallic ligature. This precaution counteracts only, in a very small degree, the inconvenience which attends their use; they are little used at the present day.

As to the methods advised by some ancient authors for maintaining dentures suspended in the superior jaw, or simply to the gums, by threads or crotchets passed through holes made in either of these two parts, we judge it as barbarous as ridiculous. We are astonished that an author like Delabarre, should not fear to expose himself, by speaking of it, but re-

commended its application to the upper jaw, by declaring that, *whatever might be said of it, the operation has never caused the least accident, because the perforation of the bone is not painful, as we are not liable to encounter large vessels, or important nervous branches, and the wound is less than that which is occasioned by the extraction of a tooth.**

Fauchard had, in the meantime, already expressed himself in such plain terms, against the utility of teeth simply suspended to the gums, as might prevent practitioners of his day from employing it. He says,† “I had hoped, that the frequent abuses which are practised daily might be corrected, and that we might advise the discontinuance of piercing the gums through, in order to make holes for suspending there an osseous piece composed of many teeth, in order to replace the incisores and canines of the superior jaw. The points which fastened this osseous piece were bent like crotchets, piercing the base of the two teeth in the middle of the artificial piece, and running through the gums, suspended from these holes in the manner of ear-rings; in such a manner that this was, so to speak, a wearing piece, which obeyed not only the impulses of the tongue, but still more, that of the exhaling and inhaling air. This piece pulled and troubled the gum. I have learned from a lady, who experienced the inconveniences of this kind of fixture, that a cough fortunately delivered her from a part of this grievous fixture. It was necessary that this lady must have a great desire to have her mouth furnished, in order to undergo *so cruel*, and at the same time so ridiculous an operation, without speaking of the dangerous consequences that might result.”

“I cannot even understand,” adds Fauchard, “how a dentist could be so little jealous of his reputation, as to thus expose it, particularly at Paris, where so many able men of all professions are found.” This observation of Fauchard’s is certainly still more applicable to our epoch than to that in which he lived, and where dental prosthesis was scarcely an art.

* Work quoted, volume ii, p. 411.

† Work quoted, vol. ii, pp. 289 and 290, of 1786.

Those persons who might be seduced by the words of Delabarre, in favor of artificial pieces suspended by means of ligatures passed even through the thickness of the maxillary bones, might, perhaps, object that the opinion of Fauchard is not opposed to them, since he only speaks of pieces *suspended to the gums*. To that we reply, that if, as no person can doubt, the perforation of the bone is more dangerous, and more painful than that of the gums, all that which Fauchard says is infinitely more applicable to those which practise the first operation than to those who confine themselves to the second. If they still doubt the reprobation with which they will be received by every physician of our day for similar operations, passing from the theory to the practice, we would address to them these words, that one of the collaborators of the *Dictionary of the Medical Sciences** suggested, who wrote at the same period Delabarre did, attempts being made at this same time, by a dentist of Mayence, to practice these operations.

"This cruel operation appears to us, at least, useless, if it is not dangerous. A good mechanical dentist has no need to have recourse to it, and he must be greatly smitten with the mania for innovating, or for singularizing himself, in order to exhume for procedures which, as these, tend to carry the art back to the ages of barbarism, where the surgery of the Arabs knew only, were fire and caustic, and had, for example, no other method of arresting hæmorrhages, than by cauterising the wounds with burning oil." The inventors of similar methods have evinced a great sterility of imagination; they essentially depart from the medical philosophy of the present age, whose object is to alleviate suffering humanity, by employing the most simple means."

To conclude, whatever may be the nature of ligatures employed as a method for maintaining pieces of artificial denture in the mouth, they always have this inconvenience, that of loosening the teeth around which they are attached. It is in vain that we have been careful to choose those teeth which

* TOURNER, already quoted, vol. viii, pp. 30, 31.

are the most solid, and that we have diminished, by small spans resting upon the horizontal surface of these supports, the tendency which ligatures all have of sinking under the gums; all the efforts which are felt upon the piece are rapidly transmitted to its extremities, and from thence to the places where they are attached. Thus, it is necessary, when it is possible, to spread the effect upon many points, and, in every case, to avoid wearing ligatures.

Of Springs.

Independent of elastic agents which fasten artificial pieces by acting by compression upon the teeth more or less near, we even believe, in dental prosthesis, that springs, whose effects are confined to a pure reaction, that is to say, which tend unceasingly to maintain separated, one from the other, the two pieces opposed to the one they hold, yield to the occlusion of the mouth, in order to react at the moment of its opening, and to follow, consequently, the principal movements of the jaws. These springs apply, as we say, to double dentures, complete or not, nearly always go in pairs, then fasten from each side to the same places, in order to equilibrate regularly, and curve from the depth of the mouth in order to accommodate itself to its concavity.

In the infancy of our art, these springs were made of simple layers of horn, of bone or of steel; but it was soon perceived that the two first substances, susceptible of deteriorating by the swelling that they experienced from the part of the humid heat in the midst of which they performed their functions, were not desirable, and that flat springs, of steel or any other metal, had too limited a development to follow either the lowering of the inferior jaw, or its lateral movements.

A kind of spring was then sought for, 1st, capable of imparting equal movements to those of a machine placed upon the anterior portion of a lever, whose support is one of its extremities, whilst the other movable in different directions exerts, particularly, a great depression; 2d, of an easy use, applicable to the plurality of cases, and neither being trouble-

some to the tongue nor to the jaws; 3rdly, passing behind the length of the denture, and applying in front in such a manner as not to be perceived at the opening of the mouth.

From thence we have *spiral ressorts*, (or springs,) that is, springs with *cylindrical stems*, and contorted upon its middle part; those with *double articulated plates*, forming a reactor fixed upon the side of the dentures, called grasshopper-legs; those with super placed plates in the manner of a carriage spring, which we had employed before any author had given a description of them: with undulated plate, with simple and double scrolls.

Spiral Springs.

Of these various springs, which may all have their own merit, the most useful at the present time, the only one which dentists the most desirous of succeeding use, is the spiral spring, which, with the advantage of a reaction, easy to regulate at will, and distributed in all its length, can, consequently, act also in a horizontal direction from below upwards, joined to that of gliding easily upon the interior of the jaws by its rounded surface.

Delabarre* is completely wrong, when he places the invention of these springs only at the period of Bourdet, who speaks of them only in 1756,† and when Laforgue‡ pretends, that in 1785 they were scarcely known; they existed, and were used, even before Fauchard, who expresses himself thus in regard to them:|| “We now use in order to join together the two dentures, with hinges and *springs* in the form of a screw, or simply curved in a spiral manner.”

If Laforgue had known this passage of Fauchard, he would have been spared the trouble of denying that Lemaitre was the inventor of spiral springs. To Lemaitre,§ a French den-

* Work quoted.

† Work quoted.

‡ Work quoted, vol. ii, p. 140.

|| Work quoted, vol. ii, p. 282.

§ This Lemaitre was, however, an intelligent dentist, for as early as 1784, he had presented (to the Society of Inventions and Discoveries,) some perfect dentures upon which a favorable report was made.

tist, who, in 1803, after returning from a voyage that he had made to England, presented to the Lyceum of Paris a treatise upon these springs which was accepted as a *new and proper invention*, for extending, say the reporters, the limits of the art.

But if springs are of an ancient origin, they have, necessarily, passed through many forms and undergone important improvements before arriving at the state of perfection which has rendered their use so frequent. For instance; * 1st. They were first employed by fixing them either directly behind, which might prevent the mouth from closing, if they occupied more of the depth of this cavity than the place permitted, which happened in nearly every instance; or upon the sides of the piece, but in an immovable manner, which would prevent the inferior end from following entirely the jaw, and would often force the piece to leave the alveolar border in front; 2nd. It was for a long time believed to be sufficient to give mobility to the insertion of the lower end, and the need of diminishing their length which was opposed to the fixedness of the piece was perceived and remedied by applying an inflexible articulated lever upon the middle of one of the sides of the inferior piece.

The invention of this method of terminating spiral springs with levers articulating in the middle of each side of the denture belongs to Maggiolo; † he had, doubtless, been conducted by the idea that Ricci had had of reducing the length of the spiral from three inches, which they had, primitively, to an inch and a half, and to replace the flexible body which he had replaced with a stiff one. ‡ This has prevailed over all authors, because the result of it has been to hold the superior piece in equilibrium by forcing the posterior portion to form a counterbalance which prevents it from exerting an effort upon the front one.

Notwithstanding the slight modifications which this kind

* These reporters were Regnier, director of the Lyceum, and Donsire Dubreuil, a physician; both were strangers to the art of the dentist.

† Manual of the Art of the Dentist. Nancy, 1807. 1 vol. 12mo.

‡ Laforgue pretends, on page 143 of his work, that Ricci in constructing them, had only imitated Masse, a skilful dentist of Versailles.

of spring has undergone, we divide it, for its construction and adjustment, into *the body of the spring*, which, is the spiral properly called; into *the heads of the spring*, which are the levers by which this spiral is terminated, and into the parts by which they are fixed to the piece.

Fabrication of the Spiral Spring.—The body of the spring is made with gold wire about eighteen carats fine, which we turn upon a steel mandrel, perfectly polished, and of the diameter of a large pin. In order to do that, the wire having been received by the wire plate the diameter that we judge convenient to give to it, we pass it for the last time in the fire; then we clean and polish it, the reduction of it having hardened it sufficiently to give it the necessary elasticity; then, we either employ a machine made expressly for, or make it in our hand, in the form of rings more or less distant from each other, according to the degree of elasticity that we wish to give to the springs. Many manufacturers at Paris always have them ready made, we generally procure them already made from them.

Nevertheless, for the benefit of practitioners who, residing far off from manufacturers, or for some other cause, are obliged to make them themselves, we show how we proceed. We take a piece of wood sufficiently tender, as the fir tree, and flat, which we split; we place the gold wire into its cleft, and allow it to extend out an inch, and put the whole in a vice which we screw perfectly tight; we then take a pair of sliding-tongs; we introduce at the same time a mandrel between its bits, and the end of the gold wire; then by turning the sliding-tongs with the right hand, we force the wire to ascend through the cleft of the piece of wood upon which it straightens itself in lengthening and rolling upon the mandrel, the left hand sustaining it, and giving it the proper direction. The rubbing that the gold experiences, by passing between the two sides of the piece of wood, suffices to give it the necessary elasticity.

Heads of the Springs.—Spiral springs once adopted as the most sure and the most solid, and the necessity of terminating them with inflexible levers being acknowledged, we next

proceed to attach heads of the most convenient form for sustaining them, and facilitating their movements. It was at first believed, that, inasmuch as the inferior jaw alone is movable, it was useless to have the springs so in their attachment to the superior piece; but experience soon taught that although fixed, this latter was not constantly maintained in place, receiving as it did, shocks from the inferior, the effect of which could not be moderated. They were then articulated above as well as below.

These spring heads all terminate towards the part to which they should be attached by a small flat shield, and pierced with a hole destined to receive the peg, around which the spring should move, are formed of pieces of gold or platina being generally fourteen or fifteen millimetres long, and about one millimetre in diameter. Some are hollowed in the middle through their length, in order to receive the extremity of the spring which penetrates it with force, and which we fasten by a silk waxed thread, introduced through the end of one of these tubes passed through the other, and confined on each side by a double knot; the others are solid, but those of their extremities which should articulate with the spring are thin and tapered in order to be introduced and screwed in the interior of this spring, which body held as in the preceding manner, becomes permanently fixed.

Some practitioners are satisfied, in making heads of springs to simply bend upon itself a wire of platina from thirty to thirty-six millimetres, but much harder than the wire of the spring, and whose two branches are united and properly filed for entering the body of this latter, leaving between them, at the point where they are bent, an opening in the form of a ring, intended, as in the other case, to receive the attachment of the spring, which is an axle or rotation pivot.

As to this latter, it is the same, whatever may be the form of the spring head; but it necessarily varies according as it is adapted to an osseous base, or to a plate, or mineral cuvette. In the first case, it is simply a piece of gold or platina of about one millimetre in diameter, and ten or twelve millimetres in length, of which two-thirds are tapered in such a manner as to

form a body of a screw intended to be introduced into the substance of the base which is pierced for it. The part which remains projecting from the floor of the base, a soldered burr, and the exuberant pivot which should form the axis of the movements of the spring is itself tapered, in order to receive a small screw with a rounded head, or better, a drop of oil, which we place on it when the screw head is introduced. In the second case, that is to say, when the spring attachment is to be fitted to a metallic base, it is soldered to this base, either directly, or by means of a small simple plate, or moved upon a vertical stem, and the overplus is arranged for receiving the head of the spring.

The form of a swivel has been given to the terminal extremity of the spring heads; it was then used by closing the attachment of the spring with a screw. A second burr was then soldered to its extremity, which left, between it and the first, the necessary space for the rotation of the spring head. But this method is less advantageous than that which consists in making a continued stem, because the point at which the two branches of the swivel touch does not offer a sufficiently united surface for giving the necessary facility to the rotation.

Finally, with a view to make springs more movable in a horizontal direction, if we wish it transverse, we have conceived the idea of dividing the length of the lever which forms the head with an articulated joint, whilst others have given to them the form of a crescent, increasing the development of the springs themselves. But these methods appear to us, to be completely useless at the present time, experience having demonstrated that those which we have described, accomplish perfectly the end that we had desired in using them.

Adjustment of Springs.—One important thing remains to be considered in the use of springs, that is the determination of the precise point of the denture upon which they should receive their support, and consequently be fixed. If they are placed too far back, and exert too much effort in sustaining the piece, which poises in front, in holding the two parts constantly in place; on the contrary, if they are placed either too

far in front or too far back they force the piece to leave the alveolar border upon which it rests ; this is demonstrated by experience and an application of physical laws to the solution of the question.

Now, what are the rules that authors have established in this respect? Maggiolo advised the insertion of the springs in the middle of the two lines forming the sides of a square. Confining the piece in such a manner that it would touch in every direction the sides of this square. But it is evident that if this plan would answer for a denture composed of two pieces, with a development perfectly equal, it would not for one of unequal pieces, because the point furnished by this method of measuring being more on the anterior plan for the smallest piece, the springs in this case would not correspond.

Oudet, desirous of solving the question in terms which would appear very scientific, pretends that it is the *geometrical centre* of each branch upon which the springs should be inserted. If by that this dentist means the centre of the space comprised between two parallel lines passing, the one behind the extremity of the piece, the other before the central incisores, he has only repeated that which Maggiolo has said, and the objection that we have made to the opinion of this latter is altogether applicable to him. If, on the contrary, by a geometrical centre, Oudet means the middle of the extent of each side of the piece, the necessary result of it is, that this point would advance as much before this as the curved part of this side would pass, in redressing the horizontal line which would be supported upon the two central incisores ; but then the spring would be too much in front, inasmuch as it would, generally, correspond to the commissure of the lips, nearly at the point which separates the canines and the first small molares.

Delabarre, that part upon which we would expect a profound examination of the question with which we are occupied, has answered in too brief a manner, particularly for persons who wish a statement of *why* and *how*, in saying,* "I

* Work quoted, vol. ii, p. 448.

think that we should adopt the following as a rule, and which we should rarely break, viz. to place the articulation of the springs in such a manner that they could not be perceived. . . . No reason should oppose that which I have here established." As to Maury, he merely* says, that "the only precaution we should take to insure success in the use of springs, is to carefully select their true point of support," and to give as a principle, that "the dentist will always do it when he is in the habit of constructing these kind of pieces." Lefoulon is still much less explicit and more accommodating,† for he expresses himself simply in regard to it in these terms: "It is then only by groping that we can find the proper place for the support of the springs."

For ourselves, we sum up our opinion in these terms: whatever may be their form, they should always be placed in such a manner that the two pieces of the denture should be held in a perfect equilibrium, and this important condition can be filled only in proportion as the two points of sustentation are continually perpendicular, the one to the other, even in the case where one jaw exceeds very much the other in front. If it would be necessary to point out precisely the place, we would say, immediately behind the second small molar in the superior piece, and directly behind this same tooth in the inferior. We conceive, however, that this perpendicularity of the axis is not as rigorously necessary when the dentures may be fixed to the remaining teeth; as to the support that these teeth give, either directly or indirectly, it is always necessary to profit by it, because much may be sacrificed to the desire of rendering springs invisible and of no pain.

The difficulty that we experience in finding the precise point of the denture upon which the springs should be placed, and the disagreeableness which follows its fixation upon a place where we are often obliged to change it because it is not convenient, has given birth to a method more complicated, it is true, than those of which we have here spoken, but which has this advantage over them, of permitting all the necessary attempts for discovering this point.

* Work quoted, p. 386.

† Work quoted, p. 430.

This method consists in fixing the articulating pivot of the spring upon a small plate of platina cut square, but a little smaller than the thickness of the base of the denture, and pierced with a small hole at each of its four angles. This plate, supporting the spring, is, at first, confined by wax, or any other agglutinative substance, then changed, if it is properly placed. The place once correctly selected, we hollow upon the base, (osseous base,) a slight notch for receiving it, and we fix it permanently, by four small gold screws with a sunk-head at least, if we do not wish to pierce it through and through by the pivot itself, which would be riveted on one side, and would form an axis on the other.

The extreme mobility of spiral springs has given to some practitioners the idea of restraining their action only in the place where they should move, by maintaining them in place on the pieces which they should support, by means of small hooks of gold or platina in the spot in which they should only act, and which they have designated by an expression not less new than significative, viz. *limitators*.

However specious as this idea may be in theory, it offers nothing very serious in practice, in regard to the end that those propose who have sustained it, because the jaws exert always a pressure upon the springs, so great as to prevent them from deviating from the movements which belong to them. But if these small fixtures are not useful, they are necessarily detrimental by the thickness they give to the piece, and the pain their angles give to the parts which come in contact with it. Also, we think it prudent to renounce it, and to satisfy ourselves, when it is necessary to confine the action of the springs above and below, by fixing in these two directions a small piece of leather for it to rub against.

We have said, at the commencement of this article, that springs, such as we have described, were intended to maintain the two pieces which compose a denture, apart, and which naturally approach in the occlusion of the mouth. We have neither wished to say from that, that these two pieces should be necessarily complete, nor that they should be equal in force, that is to say, for the number of the teeth. Very often,

in effect, we have to replace the teeth of the superior jaw, and some only in the inferior.

It is always by springs, such as we have described, that pieces fit for filling each of these indications are maintained in the mouth; but the teeth which shall furnish the lever plate, although perfectly arranged, each in its proper place, should be united by a band, a kind of metallic plate, which, arranged in a manner so as to apply exactly behind the dental arch, forms, with the parts composing the piece, an assemblage sufficiently solid to give to the springs a support completely immovable. This assemblage should even extend to the most distant part of the alveolar border, in order to correspond to the superior piece of the denture.

If the inferior jaw had preserved all its teeth, we solder for each side a supporting band for the springs, and of which there may be some question, with two rings embracing the two or three last large molars, and its solidity might be assured by means of spurs, which, dividing it in as many compartments as there are teeth existing, would insinuate themselves into the posterior inter-dental spaces, without, however, being allowed to touch the gums; we name these pincer-springs. For a long time the form of a die was given to these springs; but in order to avoid, as in the use of the inclined plane, such as were at first used, the accumulation of alimentary and other matters, we give to them, at the present day, the form of a night-cap, or of a diamond, by soldering upon their external face two small metallic stems, which divide the outward from the inward, and the inward from the outward, crossing upon the summit of each molar, and thus counteracting the pressure exerted by the spring, and, consecutively, by the ring upon the inferior jaw.

This apparel, as we see, resembles in all points that which we have described, and which we employ for giving a solid support to the attractive bandages intended to maintain the different ligatures by means of which we endeavor to straighten irregular teeth, particularly those which are oblique in front. The credit of the first idea of this belongs to Fauchard; for no person that we know of had thought before him of fur-

nishing the superior jaw with a complete piece maintained by a reactive agent resting below upon an incomplete piece, or even upon a similar one. The following is a proof of it.

"We may," said he, "*adjust, likewise, in the superior jaw an entire piece of artificial teeth alone; for, in order to hold this piece, it is necessary to place in the inferior jaw a *similar one*, according as the inferior jaw has all, or only a part of the natural teeth which may sustain and strengthen the piece placed in the superior jaw. These circumstances have induced me to invent a machine which, being arranged in the manner that I had desired, was adjusted in the superior jaw so that it might perform the same use as the natural teeth.

"In order to construct this piece, it is necessary to examine the number of teeth that remain below, the size, situation and the dimensions of the gums, &c.; then we construct two plates of gold or silver, about one line and a half in length and a quarter of one thick; these two plates, thus fabricated, we curve upon their largest face two half-circles, that we may adjust, the one upon the anterior, the other upon the exterior face of the gums of the inferior jaw. The plate which forms the exterior half-circle should be longer and more curved at its two extremities, according to the height and thickness of the teeth and gums that it should embrace. It is raised above the teeth, and is bent in the place where its curvature should form an elbow. Upon this piece, thus constructed, we mount *by springs* that which should represent the artificial teeth of the superior jaw. . ."

Finally, if in the most of cases the springs are used in pairs, we perceive in the meantime how we can employ but one, on the one side, for maintaining two pieces occupying the depth of the alveolar arches on this side, and upon which there exists no teeth which may give the necessary support behind. We have made, not long since, a piece of this kind which

* Work quoted, page 261, &c. The chapter from which this quotation is extracted has the following title: *Description and use of a curious machine composed of a complete superior denture, united by springs with a piece of gold or silver which embraces, by means of two half-circles, and of two handles, the teeth of the inferior jaw.*

succeeded very well, for a lady who had lost all the left large molars, and whose absence had occasioned a sinking of the jaw, which formed a striking contrast with the opposite side, so much so that it was but rational to suppose that she should seek to remedy it. The two pieces were fixed to each alveolar arch by crotchets embracing the small molars. We might, in the same manner, employ this method for fixing a single piece above, the spring resting below upon a similar one, which should embrace the teeth still existing upon this side.

The Application of all that which precedes, in regard to the Particular Construction of Various Kinds of Ordinary Pieces of Artificial Denture.

The enlightened student who will read, with the necessary attention all that which we will say in the course of this chapter upon dental prosthesis, and who will see each of the operations here described, practised, by frequenting the workshop of the dentist, ought not, it seems to us, to find himself embarrassed with any kind of a piece, whether *simple* or *complicated*, in the acceptation that we have given to these two words. In all, in effect, he will be obliged,

1st. To take the most minute impression, and, consequently, as rigorously exact as possible, of the toothless place or places ;

2nd. To make the mould upon which will be adjusted and stamped the supports of these pieces, if the supports are metallic, or after which they will be sculptured if their bases are of animal substances ;

3rd. To determine the nature of the substance that should be employed in preference to all others for supplying the loss which it shall remedy ; a determination which depends particularly upon an attentive examination of the mouth ; then to unite the teeth to their bases ;

4th. Finally, to choose amongst the different methods of attachment that which is most suitable for maintaining solidly, and, particularly, without injury to the neighboring parts, the piece permanently in the place it should occupy.

All these things we have studied with sufficient detail in order to be applied to the plurality of cases, particularly those which most commonly present themselves in practice.

Now, of what true utility would it be to give, as most authors have done who have written upon the mechanical portion of our art, separate examples of each one of these pieces: pieces of a *continued series*, that is to say, composed of many teeth juxta placed; pieces of an *interrupted* or *interspersed* series, that is to say, composed of teeth disseminated, with spaces between them for those which remain sound or at least standing; finally, *pieces of mineral or human teeth, mounted upon a base of sea-horse, or upon metallic cuvettes, &c. &c.* of what utility? none, excepting to increase the volume, and uselessly to perplex the mind by fastidious repetitions.

Do we wish to have a proof, a completely unobjectionable proof of this assertion? we have one in the description given by one of the first authors, Maury, for example, of a complicated *piece of many natural teeth mounted upon a base of sea-horse.*

"When we wish to mount, says this author, natural teeth upon a base of sea-horse, the first thing to do, is to adjust it well in the mouth; and in this respect we will not repeat that which we have said in speaking of pieces sculptured on sea-horse, the method of adjustment being always the same, whether the piece will be furnished with natural or incorruptible teeth. Thus, then, after having assorted and selected them, as nearly as possible, similar to those which they should replace; after having sawed their roots to a proper height, we place them upon the animal base in their respective position, and maintain them there with a little sealing wax. That done, by means of a gimblet mounted upon a drill, we form in their roots, and at the base which supports them, a small hole in which we put a peg in order to fasten them for the time being, the one to the other, and we replace this peg sometimes by a larger one, sometimes by two smaller ones, or even by a screw," &c. &c.

What can we find in all this which would not be perfectly understood without, and which would be of use to the stu-

dent who understands all that we have said upon the adjustment of hippopotamus pieces, and upon the choice, perforation and mounting of natural teeth: and what would be the use, when one has devoted several pages beforehand to a detailed article on *ligatures*, *plates*, *crotchets* and *springs*; in a word, on the different methods employed for maintaining artificial teeth in the mouth, to add a particular description of a piece.

"Artificial teeth, whose union constitutes complicated pieces, may be fixed *upon their base* (the author, doubtless, wishes to say, *upon the alveolar border*) by different methods of attachment, sometimes in effect, we employ simple ligatures, sometimes, crotchets, or springs," &c. &c.

The observation that we are about to make is no less applicable to Delabarre than to Maury and others. We may judge by this description of the construction of a *denture of a continued series*, which he calls a *simple piece with enamel*:*

"We select a piece of hippopotamus which has the proper dimensions for filling the breach; it is particularly necessary that it should describe the same portion of a circle as that of the vacant space. We should prefer a hard not chalky enamel, of a pure white and not blue, presenting a thickness with the least possible projections. This piece should be higher than is necessary, so as to be able to affect the incrustation, and even to remedy the defects that might be made in working it. We remove with a rasp or grinding apparatus, a portion of the part not enamelled, preserving it only of a length of six or eight millimetres for forming a base intended to rest upon the roots, if the piece is to be attached with pivots; or from twelve to fifteen, if it is to be fixed by other agents. . . It is well, before advancing too far in the work, to try it upon the patient in order to ascertain if there is no essential fault to correct. . . We must not be satisfied in sculpturing the teeth, to cut them clumsily, although they might be for those who had no idea of human anatomy. The incisores should have the form of a flattened angle, but swollen in front and hollowed behind," &c. &c.

* Work quoted, p. 183, &c.

Notwithstanding some variations, necessary for the special destination of the object, the description that Delabarre gives of the method of constructing the piece opposite to that of which we come to speak, that is to say, a *denture of interrupted series*, of a single piece of *enamelled hippopotamus*, is absolutely the same, as the following will prove:*

“When we wish to make a slanting piece from a single piece of enamelled hippopotamus, we must select a piece whose enamelled arch will be the same as that of the portion of the mouth for which it is intended. In order to succeed, we cut a pasteboard in the same manner as we would the piece itself; we cut it to receive the teeth upon the model, making with it, the convex or anterior border. With a pencil we trace the form of this pasteboard upon the piece of hippopotamus, having care to place the projections which might be upon this substance in the places which should be cut off. The rasp and grinding wheel are the proper agents for sketching it, which, being executed, will facilitate the incrustation with the graver,” &c. &c.

It seems to us, after having established the principles which should serve as a guide under every circumstance, and having observed with care each object which belongs to the construction of a piece, in all the details appropriate to the diverse usages that we may make of them, it would be useless to give particular examples of each kind of piece. We will then confine ourselves to the examination of certain objects which, by their special nature, depart from the rules that we have previously given; such are *complete dentures* and *maxillary* or *palatine obturators* that are united. We regard that which belongs to lingual, labial, nasal, or facial prosthesis altogether foreign to the art of the dentist.

Exceptionable Pieces.

By this expression, *exceptionable pieces*, we do not wish to say that the objects of prosthesis that we now designate, de-

* Work quoted, vol. 1, p. 248.

part completely from the general rules that we have established for the construction and adjustment of pieces which are most frequently employed, and form those that we have called *ordinary pieces*. For these, in effect, as for those, it is necessary, first of all to take the impression of the parts, obtain them in relief, construct the bases, fix the teeth there, and to provide means for maintaining them in place; but the pieces of which we shall now treat, depart so much from general rules, as to require some important modifications, particularly of detail in the application of rules, and we believe it right to give a particular description of them.

*Complete Dentures, vulgarly called Rateliers.**

In all that we have said as far as the present, as much upon the methods of taking impressions, as upon the manner of using these impressions as faithful guides in the construction of different pieces of artificial denture, we have always admitted that the jaws were not completely deprived of their teeth, and that the few that were remaining of them were always sufficient, nevertheless, was it only one, provided that it had its usual length,† to appreciate the natural degree of widening of the two jaws, and consequently the length to give to the artificial teeth with which we intended to supply them. There exists several cases, unfortunately, very common, where the alveolar borders are completely unfurnished.

In these cases, must we content ourselves with taking the impressions of the two jaws, and stamping after these impressions of plates upon which we will mount the teeth placed as these are in the natural state, and of a height equal to those that teeth generally have? Not exactly; because the jaws,

* We advise young practitioners to employ as little as possible the expression of *ratelier*, in order to insensibly expunge it from the vocabulary of our art.

† That which would not be if it was decayed in the superior part of its crown, because it would then be too short; and which would not be if it remained long without an antagonist, because it might elongate in advancing from its alveolus.

the inferior particularly, have experienced by the fact of the total loss of the organs which furnish their borders, changes of which it is of the greatest importance to notice exactly.

These changes effect both, in the shrinking or sinking of their alveoli; in the inferior, upon the opening of the angle which, as we have seen in the anatomical part, takes among old persons the form it had in infancy, where the body and branch of the bone unite themselves in an angle so obtuse that they seem together.

The first of these two changes, the shrinking of the alveoli, has for its result the overturning of the jointing of the inferior jaw by the superior, because this sinking is made from without inwardly, for this latter which shrinks a little in diameter, and from within outwardly, on the contrary, for the first whose extent then augments a little. The other change, that which results from the opening of the angle of the inferior jaw, has for an inevitable effect: 1st to throw the body of the bone forward, for the articulating condyle remains fixed: 2nd to draw the two jaws near to one another, so much as to efface in the whole length of their body the space which separates them when they were furnished with teeth.

If you take then a complete denture the most ably executed, but copied from the jaws of adults furnished with their teeth, in a word, composed of bases perfectly horizontal upon which will be implanted perpendicular teeth, and when you place this denture upon the jaws which have undergone the transformation that we have described, two things will happen; first the inferior denture will glide before the superior; afterwards the widening of the jaws by the molar teeth, whose place had disappeared, will be effected only by the painful pulling of the masseter muscles, and other elevators of the jaw.

We do not believe that the change in the form of the inferior jaw is the result of old age, for it is rather the inevitable result of the total loss of the teeth. Thus we see old persons having preserved them, to have the angle of the jaw nearly acute, and the chin scarcely projecting; whilst we meet with

many adults who have lost them all at an early age, and who have nevertheless the entire physiognomy of old age.*

From thence follows the necessity for those persons who wish to preserve the habitual expression of their physiognomy, and to have the least appearance of decrepitude, of replacing their teeth as they lose them.

Aware of these facts, the dentist who would have to construct a complete denture, not as an evidence of art, but to be applied usefully upon a person who was for some time completely toothless, should commence by taking an exact impression, but each jaw separately; a method preferable to the habit that some dentists have of taking an impression of both jaws at once in wax, and whose result rarely gives the true relations between the two maxillaries. He should then construct these moulds, but he should be careful to articulate together the two parts, although no tooth exists, he will be entirely ignorant of what degree of space he should leave between them; the length of the whole of the two dental ranges will alone regulate this widening.

The plaster moulds being made he should obtain those in lead or in any other metallic substance, since it is particularly for large pieces that we have established the necessity of it; he should stamp these plates, then adjust them upon the gums, and afterwards establish them according to the rules that we have heretofore established. Then he should attend to the teeth. But what length should he give them, and how should he establish this length in a satisfactory manner? It is in this that the difficulty consists, for many reasons: first, because the act which consists in taking a wax impression, for stamping is so painful to many persons; second, because in pressing them with much force, the gums might flatten, and the mould is not as exact; third, in taking an impression thus, the inferior jaw advances under the superior, and we give it two large a surface.

* Delabarre, who knows this fact, has acted in opposition to himself in saying, "it is not sufficient to remove all the teeth to give to the face of an adult the resemblance of old age; from the fact it takes only the aspect of it."

Some dentists, believing that they could overcome this difficulty by determining the medium height of the two dental arches, in their different points in an adult, have estimated that the widening of the jaws should be, altogether in front, thirty-eight millimetres, and altogether behind twenty-four; whilst others have accorded thirty-four, and even thirty millimetres in front, and eighteen or even fifteen behind, wishing from thence not to change in too marked a manner the entire physiognomy.

We think, that it is absolutely impossible to establish *a priori*, and even in a purely general manner, the precise degree of this space; because in the place which corresponds to the incisores, this degree may be regulated by a glance of the eye, which satisfies better than all the measures that we can take, that which agrees with the figure of the person; and, towards the posterior molares, by the opening of the angle of the jaw. This opening will be as much more prominent as the complete absence of the teeth has been more or less ancient, as we shall demonstrate, as also as they have been lost at intervals more or less distant from each other; for it will necessarily suffice that some of them are left, particularly behind, so that the transformation that we have mentioned shall not be effected.

Observe how the most of practitioners proceed, and this which Lafoulon gives wrongfully as a new invention of his own.* When the two plates, or rather the two bases, are perfectly adjusted, they solder or rather fix temporarily to the middle part of the inferior plate, directly upon the median line, a small metallic stem from thirty-six to thirty-eight millimetres in length, directed vertically, in such a manner that its superior extremity shall touch the middle of the opposite

* Work quoted, p. 408, &c. This author seems, however, to have no idea of the transformation that the angle of the inferior jaw undergoes by the absence of the teeth, and, consequently, of the difference that should exist between the length of the teeth of replacement, and the natural ones, since he expresses himself in speaking of complete dentures, thus: "We have no need to add, that the teeth should be *like* those they replace."

plate; then they solder two other similar ones upon the lateral parts, one on each side. They insensibly diminish them with the file, until they are satisfied that they have the precise height appropriate to the figure; they then furnish these sides, as far as the end of the base, with a roll of wax arranged as the dental range, but exceeding the stem from four to five millimetres in height.

The two bases being then placed, they require the patient to close the jaws so that the occlusion of the mouth will be arrested by the pivot fixed from base to base. In this effort, the wax will be necessarily stamped, and the point where it stops this stamp gives, in the whole extent of the alveolar circle, the measure, but the *total* measure which the teeth should have above and below united, a height which we then divide between them *as conveniently as possible, by measuring as they say, the length of these teeth, after the middle of the distance which exists between the two cuvettes.*

They continue thus: "These precautions being taken, both pieces must be withdrawn with extreme care, in order not to derange the wax teeth." Nothing better assuredly; but they add: "When the whole is out without accident, we detach the springs and place the inferior cuvette upon the plaster mould which serves for their adjustment; but, previously we make some deep notches in the posterior part of this same mould, and which we moisten. When it is thus prepared, we form behind it a kind of very small trough with a leaf of lead thin enough to be easily bent. In this trough we pour some plaster which prolongs the mould by forming a heel there, in each angle of which we form two holes, for receiving the heels which will be adjusted in the superior mould."

"This is obtained in the following manner: we place the superior cuvette upon the inferior, by applying the extremity of the three pivots upon the small holes which are impressed in the wax and whose office is to mark. Upon this cuvette we place the mould which belongs to it, and for fear that it might move, which should not happen whilst the plaster mould is drying, we fix it steadily with several rows of very fine heated iron wire. Finally, we oil

all the part newly added to the inferior mould, and we pour some liquid plaster upon both moulds at the same time. The superior mould should by all means undergo the same preparations as the other mould so as to facilitate the adherence of the new plaster."

Well, what does the practitioner that we have named think of this method, and which he gives as the fruit of an effort of imagination *entirely new*, and which he believes a duty to give to his confreres, it is defective from one end to the other. This we can easily prove. First, the central pivot, intended to sustain the cuvettes between which the wax should be placed representing the teeth, is completely useless if we place at the same time two pivots on the sides, because it is laterally and not before that the widening of the jaws should be appreciated. On the other hand, if we place this pivot only, it will not properly sustain the plates in place so that the patient can make all the necessary movements to try the susceptibility of its attaining the end proposed, because the cuvettes would quit the alveolar border behind, or would not adhere to it.

Then, not serving to represent both dental ranges, with a single piece of wax, we should be obliged to introduce the fingers in the mouth in order to maxilate and adjust the wax above and below, and it is impossible to give to each dental range the inclination which it should have. Besides, how can we divide it in the direction of its height without changing the form which it should have? Finally, in making only a single mould for the two articulating pieces, we would experience the greatest difficulty in mounting the teeth as we should have no fixed line to govern the arrangement of their cutting edges.

Notice how we proceed : we solder upon each plate or base, to the parts corresponding to the small molares, on each side, a small plate of platina, from twelve to fifteen millimetres in length, from four to six in height, solely to sustain the wax; then we fill with two pieces of this substance, the space between them and the bases, holding these pieces, however, higher than the metallic plates. We then require the patient

to press lightly upon the wax; then we reduce it in height to the degree wished, by cutting it with a curved knife which removes it by pieces. We then arrange this wax for sustaining the jaws; give to the two layers that it forms in front, and which we have had care to flatten with the fingers, the direction that the total mass of the teeth should have, and we assure ourselves of the entire exactness of the whole, so far as that the physiognomy has returned, that it can execute all the functions which belong to the jaws, and finally, bite square in every direction.

When this imitation of the complete denture is perfectly made, and the two parts of wax which represent each a dental arch, acting well in every point the one upon the other, we make a mark upon their anterior part, so as to recognise their central point, which represents the two great incisores above as well as below; we do the same upon their central parts, so that they may always be replaced in the same relation that they had in the mouth. This second lateral mark should be repeated upon the base and made, as much as possible, upon the place that is intended to be occupied by the springs.

Then, as the bases are metallic, we slightly heat them at the concave part by the alcoholic lamp, then draw carefully from them the two circles of wax which covers them, and we fix then a small plate intended to receive the spiral spring. We then replace the wax with care in the mouth upon their plates, and fasten the springs there temporarily, so as to assure ourselves of the regularity of their action. In regard to the determination of the precise point upon which they should be placed, we were sufficiently occupied with it, in speaking of the general means of holding the different pieces of artificial denture in place, and particularly in treating of springs.

These precautions once taken, and the height of the two dental ranges obtained by that of the two pieces of wax which represent them, we make an articulated mould apart for each jaw. In order to do that, the springs being removed we place each plate furnished with its wax upon its own mould; we then make upon the internal part of the mould, in about the the three posterior quarters of its extent from the front back-

wards, a deep triangular notch ; then cover this interior and posterior face of the wax with a little oil. Then we envelope the mould through all its circumference, as for an ordinary plaster mould, with a band of very thin flat lead, or simply of pasteboard, of double the height of the mould ; then we pour some diluted plaster, which filling all the concavity of this latter, touches it everywhere, less necessarily at the place where the band of wax occupies all its circumference. The counter-mould being dry, we separate it, remove the wax and find, in placing the counter-mould in the mould, the precise place the teeth should occupy.

In regard to the method of fixing the teeth (which, may be said in passing, never exceed twenty-eight,) there are three things to be considered ; the direction that must be given to them, the order in which they should be placed, and their attachment to the base which should support them. That which we have said of the shrinking of the alveoli of the jaws shows us that those of the base should be directed a little within, so as to correct the effects of this shrinking which operates without, and those above outward, for the opposite reason. We also think that it is always better to give to the teeth of a double denture a height a little less than that which the natural teeth have, for this very simple reason that the piece will be as much less apparent as it is less thick.

In regard to the order in which they should be placed, that which we have also said of the effacement of the angle by which the branches of the inferior jaw are united to the body, would make it appear that it is first on this, that is to say, by the molares, that it would be well to commence, since it is the space that we leave between the jaws in the depth of the mouth which will regulate the length which the anterior teeth should have. But as this space is always rigorously obtained by the pieces of wax, the central incisores should be placed first, and then the molares, not fixing them definitively, until after having tried their position, not only upon the mould but even upon the mouth of the patient.

Finally, it is, particularly, for teeth making a part of complete dentures that we sustain them behind, when they are

mineral ones, which maintains them solidly united together, and at the same time on the base; but it is then useful to bring them as near as possible together, so that this band may not be perceived.

All that which we have said applies, as we easily see, only to dentures with metallic bases; but when we construct them with bases and teeth of animal substance, or to speak more positively, of hippopotamus, we should take the following course: Take the separate impression of each jaw, have the relief moulds of both, (moulds of plaster only, and not of metal, which becomes useless, since we have nothing to stamp;) these two moulds obtained, we take a second impression by means of two pieces of wax applied upon each alveolar arch; but then to have altogether the hollow of the alveolar border, as for that which served to furnish the plaster moulds, and the height of the teeth, as for metallic cuvettes. This is, doubtless, that which Maury wished to say by this phrase, by which he commences the description of a denture with a sea-horse base: "We commence by taking, separately, two impressions of both jaws," &c.

However that may be, we should make the wax reach each side of the alveolar border, precisely at a level with the base, and make it encap the gums exactly, as this latter would. Finally, we obtain, as for metallic bases, a counter-mould so as to have always a method of appreciating the true height of each denture, by holding it, nevertheless, a little more disengaged towards the internal face of the teeth, so as to correspond to the great thickness which the base inevitably has in this case.

This being done, we take the piece of hippopotamus which we intend for each denture; cut it exactly upon the piece of wax representing the teeth, leaving it two millimetres long, so as to provide for the slight deperdition that it might experience in this direction by the intersecting of the teeth where they are regularly cut; we present it upon the plaster-mould, and incrust its base which should bear upon the alveolar border, by means which we have previously given; then we try it in the mouth of the patient, each piece separately,

then both together, so as to establish their true relations; we mark upon each piece, vertically, the line which should separate the central incisores, and we withdraw them from the mouth in order to trace with a crayon the portion which should be devoted to each tooth and which we then sketch.

We do not proceed farther without again trying the denture, so as to remove by the rasp or graver those points which might be superfluous. As all that which relates to each piece, besides the teeth, is obtained and acts only by the relations established between them, we may maintain them united by a little wax interposed upon the different parts of the surface where they touch and are withdrawn in this position, then placed upon their primitive moulds. We then make from these an articulated mould, that is to say, only by the addition of a certain quantity of plaster added to each mould and arranged as a projection in the one, and as a cavity in the other, as we have previously said, we place these two pieces in similar relations to those in which the mould and counter-mould have been put, which have served to give to each dental range the proper height. To finish the teeth remains only to arrange them in such a manner that in front the inferiors cross under the superiors, and that, upon their sides and behind, the tubercles made upon the triturating face fall just in the depressions made in their antagonists.

Finally, when we wish to mount human or mineral teeth upon hippopotamus bases, intended for a complete denture, we proceed exactly as we do for pieces whose bases and teeth are hippopotamus; only, when the piece is properly cut and corresponds exactly to the other piece, we mark on each side the place intended for the two large molares, then we remove all the intermediate portion intended for the ten teeth that we propose matching. We sculpture the molares in such a manner that their tubercles indent well, and mount to the height obtained, the human or mineral teeth, according to the rules that we have given.

We are particular, also, we repeat it in opposition to the ordinary opinion, not to fix the springs permanently to the bases before placing the teeth irrevocably there: the regular action

of these springs being one of the most important points in the use of this kind of piece, all should, so to speak, be sacrificed for it; in such a manner, that if the points upon which these springs should rest being well ascertained, those which were tried, before the piece was furnished with its teeth, not seeming sufficiently strong, we substitute for them others of the same length, but more resisting.

In regard to the question seriously agitated by some dentists,* whether the springs should be gold, brass or iron, it is necessary to be very fastidious to suppose that some practitioners could be found so ignorant of indispensable matters in the exercise of their profession, and so prodigal of their time, as to amuse themselves with calculating the results with brass or iron springs in comparison with gold.

We have noticed, that all the details relative to the construction of a complete denture enters into the general considerations with which we were previously occupied, and a new development of which, here, would form a useless repetition. We might, however, establish, upon this subject, under the form of propositions, the five general rules which follow:

1st. In the construction of a complete denture, every thing should be so arranged that the two pieces of which it is composed, reaching as far as possible in the mouth, fill all the alveolar border, which they exactly encap;† that, touching every where the soft parts, in the midst of which they should habitually rest, they will be most intimately united to them and follow their various movements without experiencing any unexpected shocks.

2dly. The action of springs is as much easier, and more regular, as the superior piece is lighter, and as the inferior is heavier. It is also for upper pieces that cuvettes of gold are preferable to those of platina, and even for which palladium

* Lefoulon, work quoted, p. 406.

† This does not destroy that which we have said of the propriety of putting only twenty-eight in complete dentures, the two last molares being generally formed of a single piece.

might find an useful application; whilst it is for lower ones that bases of hippopotamus, or cuvettes of platina, particularly, are fit: the first, where the alveolar borders have experienced a great depression, the second where this depression is not very prominent.

3dly. The superior piece would be as much more solidly maintained and easy to support, as it would reach the alveolar border nearer on the internal side, and as it approaches nearer the palatine vault, without, however, advancing upon this latter, because it would disguise the taste to no purpose, and would impede the movements of the tongue.

4thly. Experience has taught us that too much importance must not be attached to the advantage that author's believe bases of hippopotamus have, because of their mild contact with the alveolar borders and gums. Persons who make use of complete dentures, habituated in general so readily to metallic cuvettes, that one has frequently erred in depriving these latter of the inappreciable merit of being unalterable. We, also, do not hesitate to furnish most of our hippopotamus bases with a very thin metallic leaf, a kind of *cuvette*, which, increasing the weight of the piece very little, gives it a solidity and permanency which it cannot have without.

5thly. It is, particularly, in regard to the construction and adjustment of these pieces in the mouth that it is important to know, that some persons, for whom they are intended, hope in this case to be able, by some movements of their jaws, to correct certain vicious conformations to which nature has subjected them, but nearly, always, then, to the detriment of the relations in which the dentist had placed the two pieces composing the denture.

From thence serious difficulties often result which we may avoid, by plainly refusing to yield to the whims of the patient, or by warning him of the result obtained. We have often been styled judicially arbitrary in similar contestations, and we have, more than once, been compelled to judge contrary to the pretensions of our confreres, whose pieces were perfectly made, but which, by an excess of complaisance, or a want of attention, had adjusted these pieces in conditions which soon

rendered them impossible to be supported, and rendered them completely useless to those for whom they were intended. The fear of a similar disagreement should not, however, prevent us from condescending to the wishes of patients, when the rectifications that they require would not affect the adjustment of the piece, nor offer a possibility of its preventing its daily use.

Maxillary Obturators.

In the description of the different kinds of artificial pieces which we have examined, we have always supposed that either the osseous parts in which the teeth were naturally implanted, existed, or that these parts had not undergone any diminution which it was not easy to remedy, by giving to the osseous or metallic bases a sufficient thickness. But there are cases existing, in which the teeth and a portion of one or the other maxillary which receives these are wanting at the same time. Our art, as is well known, is not altogether unavailing in accidents of this sort, which, unfortunately, are very common, and which, although concealed by the soft parts, from the injury which it is at once anxious to repair, constitutes no less, in many instances, very inconvenient deformities, principally by the difficulty caused by the preparatory work that the aliments must receive in the mouth, or, that which is no less serious, the articulation of sounds.

Fauchard thought to remedy these losses of substances, and, although the pieces which he employed for this purpose, had neither the precision nor resemblance of those constructed at the present day, they accomplished the same end. If Delabarre had read with more attention that which this master of the art has written upon the subject, he might have seen that all the pieces which he has employed in the cases of which we treat, were not sustained with *nasal wings*; * notice the following literal quotation :

“I was consulted some years ago by a lady of the province,

* Vol. 2, p. 318.

who had lost the four incisor teeth of the upper jaw, by neglected caries, which, in consequence, had also destroyed a part of the superior maxillary bone. * * * It was on this occasion that I conceived the idea of constructing a plate which should,* *at the same time*, serve as a support for the teeth and an obturator. I composed this obturator of a plate of ivory; the tooth of a sea-horse, however, when one can be procured, is preferable; but the seam which divides this tooth throughout its whole length, renders it difficult to obtain a piece of sufficient thickness for many artificial teeth. To this plate which I adapted to the palate, I left on its convex part, a small eminence pierced at its summit for the attachment of a sponge. I next constructed four artificial teeth, which I attached so perfectly to the canine teeth, that the plate was securely adjusted, and accurately covered the hole in the palate, whilst the artificial teeth which were contiguous, fitted so well the breach of the natural teeth, as to exactly imitate them and supply their functions."

The dental obturator, described in the *General Journal of Medicine*,† constructed by Fauchard, for a man who had lost the two central incisores, the lateral incisor, the canine and first right molar, with all the part of the superior maxillary bone in which these teeth were implanted, a portion of the mental apophysis, and nearly half of the middle anterior plate of the palatine vault, was merely a copy of Fauchard's, which we have just described. Finally, instead of fixing it simply to two neighboring teeth, as the latter, this obturator had the immense inconvenience of maintaining itself by reacting agents, which exerted upon the lateral teeth of each side an effort of repulsion more liable to loosen them than the ligatures of Fauchard; and that with the advice of Duval, who reported upon this obturator, and of Delabarre's, who represents it in his work.

Whatever may be the character of the first artificial pieces

* This observation of Fauchard proves, without doubt, as we have already remarked, that he knew and had used the tooth of the sea-horse.

† Vol. i, p. 386.

the impressions which may be taken at the present day, permits them to be made with an accuracy that cannot be excelled. When the loss of a portion of the alveolar border and neighboring part of the maxillary bone only, is to be remedied, when there is no communication with the nasal fossæ, if it is in height, as is most frequently the case, the hippopotamus is the most suitable substance that can be employed, because it is more congenial to the parts, and can be more easily adapted to them, with the exception of mineral or natural teeth. As to the means of maintaining these pieces, the crotchets, acting as springs, and supporting themselves by as great a number of teeth as possible, are the only ones which it is necessary to employ.

Delestre, a surgeon dentist of Paris, presented to the Royal Academy of Medicine, some two years since, a piece of this kind, intended to replace in the mouth of an invalid, the loss of the external table, only of a portion of the superior maxillary which had carried with it many of the anterior teeth. Being retained in its place, it perfectly accomplished the object for which it was designed. This piece had, as we can see, a strong analogy to the piece which we have spoken of in another place, but with this difference, that our professional confrere had remedied only the loss of a part of the anterior table of the superior maxillary, embracing only a portion of the alveolar border, whilst we had a large portion of substance to supply, and another indication to fulfil; namely, to close an opening into the maxillary sinus.

If the loss of substance is more common to the superior than to the inferior jaw, it must not nevertheless be expected that it will never be necessary to construct an appliance only for the first, it is in truth easy to conceive that a number of circumstances may, as a wound from a gun, a cancerous affection or necrosis, that carry off a portion of the inferior maxillary, and render it necessary to fill the space that may result from it either by remedying the sinking down of the soft parts less apparent, or by giving to the bone more solidity, or simply by supplying to the denture, the part which had disappeared with the loss of the bone, or, finally, by preventing the

accumulation of alimentary substances in the cavity which would of necessity be constantly lodged there.

Authors, however, furnish no example of a piece of prosthesis of this kind, Delabarre, doubtless, had no occasion to construct one of this sort, for in the part which he has devoted to the subject, he makes no allusion to it.* Moreover, we think, he completely deceived himself, when he said that Jourdain had occasion to apply one in a case of spina ventosa. We have read, with all necessary attention, what Jourdain says of spina ventosa of the inferior maxillary, and we find nothing that authorises the belief that the idea had occurred to him.

In short, of the two cases which this author relates, in his treatise upon the diseases of the mouth, he terminates the first, by saying, that after he had removed the tumor, although the bone, *so to speak*, became *cartilaginous*, he believed all violent action should be avoided, "the body of the bone was no more than a shell." The second case was that of a young lady of twenty-seven years, which he treated as in the preceding, but upon which he applied no kind of an obturator, since it disappeared immediately after the operation, without which it would have been impossible to have determined the consequence of the disease which had been thought mortal.

More fortunate than our predecessors, we can supply the lack of their silence, by relating a very remarkable case of this kind which fell under our observation a few years since. The subject of this case was a man from forty-five to fifty years of age; it originated from a violent blow received upon the left side of the lower jaw, causing a progressive tumefaction accompanied by dull pain. The five molar teeth of this side loosened, were successively removed, and soon all the anterior table of the alveolar border detached itself from the body of the bone, leaving exposed a vast cavity, from thence and the blackish osseous lamella and cells flowed a fetid matter. Not willing to take the advice of his own physician who recom-

* Work quoted, p. 312.

mended the resection of the diseased portion of bone, he went from his native city to Paris, in order to consult some of our celebrated surgeons there. He returned from there home, and merely contented himself with using many times a day, aromatised, in the cavity, an enormous ball of cotton, which was found in his jaw. His physician decided, however, to level the wound of it by destroying, with a caustic, all inequalities and soft parts; this wound from thence took a more favorable aspect, and he returned to Paris, but not for a surgical consultation, but merely to know if he might not have an artificial piece to fill the cavity of his jaw, which not only affected his pronunciation, but which formed a hollow in which alimentary particles accumulated and tainted the mouth by their speedy decomposition. It was at this time that he addressed himself to us, and gave us the foregoing facts.

This cavity, extended from behind forwards from the union of the branch of the maxillary to unite its body to the canine, and proceeding from above down the line which continues, upon the external face of the maxillary, the anterior border of the coronoid apophysis, even to the mental foramen, was sufficiently deep to receive alone the middle part of a pigeon's egg. We commenced by filling it with a piece of soft wax in order to make it as nearly as possible upon a level with the neighboring parts, and replacing the them as much as possible, in their natural state; then, after having taken the impression of the whole of the jaw, we obtained a mould of plaster, upon which we adjusted a plate of platina forming a kind of vault which adapted itself exactly to the contour of the opening. We then soldered to its anterior and posterior parts two bands of the same metal, reuniting themselves in order to form upon each molar of the opposite side, a metallic box which perfectly encapped them, giving to all the apparel a great solidity.

This fundamental indication, essential *to stop up the opening*, being filled, we sought to fill that which was very secondary, accessory *to restoring to the diseased part its ordinary form*. In order to do that, we simply fixed upon the plate, commencing from the place which corresponded to the alveolar border, a

piece of hippopotamus, upon which the five absent molar teeth were marked. All was adjusted in order that the piece might be removed at pleasure, its weight and the precision of its adjustment, giving it a solidity which we unfortunately obtained only, in the superior jaw, by making points of support, of the crotchets whose daily removal would undoubtedly injure the solidity of the teeth to which they were applied.

We had an opportunity of seeing the subject of this operation, seven or eight months after the application of the obturator which we have described, and we have seen with satisfaction that it had accomplished not only the desired end, but still more the cavity which it covered was insensibly filled in with fleshy granulations.

Palatine Obturators.

The idea of filling the opening that may cause in the palatine vault either a congenital division of the bone of the palate, or a wound or any disease whatever of the osseous system, as those which so often result, as wounds of fire-arms, and syphilitic diseases, is certainly a very ancient idea. The construction of mechanical apparels as a means of remedying these accidental openings has long since been given to surgeon dentists; their conformation and the relations that they have with the teeth, by the irregularities that the deformity produces in the order of these, or by the support that these apparels receive from them, causes them to enter at the present day more than ever, into the boundaries of our art; we shall now enter into details relative to their construction, and the rules which should govern their use.

Authors, generally, agree in regarding Ambrose Paré, not as the first surgeon who sought to remedy the numerous inconveniences which result from this communication with the mouth and nasal fossæ, but only as the one who gave, in this respect, the most precise rules. They have reason to do this: for, as Cullerier* observes, the fact, Alexander Petronious wrote about

* Dictionary of Sciences Medicales, t. xxxvii, art, Obturateur.

fifteen years before Ambrose Paré.* "If the decayed bone of the palate falls of itself, or if we extract it, the pronunciation is altered so much so that the patient can scarcely be heard. But it is possible, in certain circumstances, to repair this loss; for example, when there is only a hole in the palate, we can stop it up with cotton, with wax, with a gold plate or in any other way that the genius of the artist suggests, having care to give to these instruments the same concave form as the palatine vault."

However, the method that Ambrose Paré advises is now with reason altogether abandoned. It consists simply in "applying against the hole a plate of gold or silver, maintained by the introduction of a sponge attached, as he says, to a stem and retained by a screw. The sponge being dry, when we place it upon the plate, swells by the humidity of the nasal cavities and prevents the fixture from falling."

This method of prosthesis had, as we see, two great inconveniences. One consists in this, that the sponge, in impregnating itself with nasal secretions, soon gives an infected odor; the other is this, that the presence of a strange body in the accidental opening, particularly of a body constantly susceptible of dilating, would not only oppose its occlusion, but would, on the contrary, continually favor its enlargement. In every case if the sponge is only of a thickness sufficient to easily enter the opening, the fixture would be liable to fall; or when it was sufficiently large to form, being humid, a pad sufficient to support this apparel, it would exert a painful compression upon the edges of the opening.

Fauchard obviated the first of these two inconveniences by an obturator of very ingenious mechanism, to which we have given the name of *an obturator with wings*. "It is composed of a plate, stem, two wings, two pivots, a vice, a screw and a key."† The plate is intended to fill the opening by the side of the mouth, the two wings to lay upon the superior face of the walls of this opening in order to fill it on the side of the

* De Morbo Gallieo, printed in 1563.

† See vol. ii of his work, p. 293, &c.

nasal fossæ, the vice to make the wings descend down until they hold the edges of the opening closed between them and the plate that they surmount, the screw to hold the vice fixed at the necessary point; finally, the key to move the vice. "Before applying this obturator," says its inventor, "it is necessary to raise the wings sufficiently to bring them near together so that they may occupy as little space as possible; this would facilitate their introduction into the hole, or breach of the palate. Once introduced it is necessary only to adjust it by means of the key.

However ingenious this apparel may be, it obviates only, one of the inconveniences attached to obturators with simple sponges, that of preventing an accumulation of nasal mucosities in the sponge which cause an unpleasant odor, and constituted their principal bulk; but, as it is an incessant obstacle to the occlusion of the opening by the compression that the edges of this solution of continuity experienced by the wings and plate, between which they were applied.

Practitioners perceiving this difficulty, were a long time occupied in simplifying the work of Fauchard; from thence we have the *bolt* obturator, the obturator with *branches*, and the obturator with a *shank*, and many others more or less ingeniously combined, but all in two plates, or rather two superplaced metallic surfaces, between which the edges of the opening were enclosed. Finally, the obturator with a hood or drum, which, if it had the inconvenience of filling entirely, or in part, the opening as the preceding ones, exerted, at least no pressure upon the edges; it was the same as the gold plate advised by Jourdain,* and, which applied upon the opening of the palate that it overlapped on each side, was maintained by a stem of the same metal, "bifurcated in such a manner as to pass each nasal opening and then turn out upon each side of the jaws," &c.

But at that moment, unfortunately too near to us, when dentists perceiving all the importance and extent of their art, enlightened by the torch of physiology, and, raising them-

* Work quoted, vol. i, p. 449.

selves to the height of general pathology, they discover that if, in the application of palatine obturators, the occlusion of the opening, by which the mouth and nasal fossæ communicate with each other, was an important indication to fill, it would, in the meantime, never be to the prejudice of the tendency that nature unceasingly repairs the injury which our organs accidentally experience. A principle was thus established for us that, whatever importance the mechanical question may assume, in this occurrence, it was, however, but a secondary thing, completely subordinate to the pathological or medical question.

From this eminently rational view, of leaving the openings of the palatine bones free in order not to obstruct the tendency that they have to fill, *juxta-placed* obturators have come into use; that is to say, simply applied, over the opening against the palatine vault, the only ones which should be employed. We should remark, to the honor of our art, that this useful reform belongs properly to dentists. Read, in effect, the word *obturator* in the most of modern medical dictionaries, and you will see with astonishment that not one of the practitioners who have written this word have even presented the necessity of widening the way opened by Fauchard, since all indistinctly advised from obturators *introduced*, but not *applied*.

And in the meantime, "before regarding," says Delabarre, with reason, "the cicatrised perforations of the palate as being of a nature not to diminish in diameter, are practitioners well assured if it is so? I do not believe it, for positive proofs attest the contrary; for the same reason that holes made in the cranium with a trepan, close nearly always in time, and those of the palate likewise decrease. Bourdet has observed it in many cases, and if my assertion would add any weight to his, I could assert the same thing: it would then be well to guard against applying a machine whose vicious construction might oppose a cure which nature endeavors to make, at least, in the majority of cases."

In effect, Delabarre might have added, that Cullerier, in the great *Dictionary of Medical Sciences*, describes only the obturator with wings of Fauchard, and speaks of obturators taking

their support from the teeth, only on the occasion of those which necessitated the losses of substance which interested, at the same time, the *palatine vault* and the *alveolar arches*. But the following phrase clearly shows that this author admitted, that obturators maintained by wings, were the only ones employed in ordinary cases, and that those with crotchets were applied only in exceptionable ones: "As the disease which penetrates the palate attacks also a portion more or less considerable of the alveolar and dental arches, to the obturator of which we speak, a *ratelier* has been added, which is fixed by the same mechanism, and which may, to attain solidity, be fixed to the neighboring teeth."

The authors of the *Dictionnaire Abrégé des Sciences Medicales*, in the number of which were Sanson and Bégin, after having developed the inconveniences that obturators with sponges have, express themselves thus: "These reasons have induced us long since to prefer mechanical obturators. The instruments of this kind which we fabricate at the present day, as the others, with a more or less extensive plate, susceptible of applying exactly to the contour of the opening that it closes, and arranged in such a manner that it continues the general plan which supports it. From the surface of this plate, which corresponds exactly to the naso-buccal opening, raises two or more *wings*, which were held back by a simple mechanism, and which, then, lower themselves by means of a stem with a screw, which a mounted key moves, applying from the side of the nasal-fossæ, upon the edges of the solution of continuity."

Lagneau, in the *Dictionary of Medicine*, one of the last published, and to the editing of which the most distinguished practitioners of our time have participated, after having spoken of obturators with sponges, whose use at the present time is not *general*, as this honorable practitioner thinks, but abandoned *completely*, Lagneau, we say, proposes as the best, the most convenient, and that which he believes the most ordinarily applied, a *mechanical obturator*, which he minutely describes and which is, in fine, nothing more than an obturator with *wings* as we know.

We see, with pleasure, from a discussion which took place

in the academy of medicine, that the most distinguished surgeons commenced to widen this way, and to partake of the advice that surgeon dentists have long since given, and which, as far as regards ourselves, has always been our rule of conduct.*

The circumstance which provoked this discussion was the presentation, by Blandin, of a young man upon whom this honorable professor had performed a very extended division of the palatine vault. This, (palatine vault,) at least in the four-fifths of its extent, being operated upon according to the procedure of Roux,† slightly modified, the patient presented then but a hole towards the middle of the palate, an obturator, says, Blandin, sufficed to regulate his speech.

Velpeau, after having examined with attention this patient, and applauded the success of Blandin, thought that the hole of the palatine vault might yet obliterate itself, and demanded, in consequence, of his learned colleague, if he did not believe that the obturator was an obstacle to the closing of this opening. This latter found the remark very just, and he declared he would warn the patient of it. Gerdy was even of the opinion that, in similar circumstances, we should not only cease using the obturator, but that it would be of the greatest utility to *aid the closing up of the edges of the palatine opening, by applying a bandage or an appropriate support.*

We say, that the patient here spoken of had been operated on according to the procedure of Roux. We do not pretend from that, as has been believed up to the present, that Roux was the first who had performed the suture of the palate in

* See the account rendered of the session of the Royal Academy of Medicine, on the 20th of September, 1842, discussion between professors Blandin, Velpeau and Gerdy.

† See his Treatise upon Staphyloraphy, or Suture of the Wing of the Palate, in 8vo, Paris, 1825, with figures. The operation which the subject of this memoir has carried away, in his time, the great prize of surgery decreed by the Institute, and forms, without contradiction, one of the most beautiful scientific achievements of the actual chief surgeon of the hotel-dieu.

France. Roux, as every one now knows,* had only the merit of giving to this operation a rank amongst the surgical operations admitted as rules and elements of the art. But we directly claim it for our specialty, since it was practised with all possible success, in the middle of the last century, by a dentist named Le Mounier.† This proves this explicit passage, contained in a collection published in 1764, by Robert, under the title of a *Treatise of the Principal Objects of Medicine*: "A child had its palate cleft from the veil to the incisor teeth, Le Mounier, a very able dentist, tried, with success, to unite the two edges of the cleft, he made many sutured points in order to hold them together, and then removed them with the cutting instrument. An inflammation followed, which terminated by suppuration, and was followed by the union of the two lips of the artificial wound. The child was perfectly healed." This quotation should follow, it seems to us, in order to make Roux and Græfe, of Berlin, agree, who are disputing the priority of this operation.

The principle after which palatine obturators should be constructed, being once admitted, what form should be given to the obturating plate? This is a question which we should not have made, while it is natural to think that this form should be that of the palatine vault itself, if we had not seen it made in a pamphlet published about two years since.‡

The author of this pamphlet, having an obturator to place, prepared to make his plate slightly rounded in the vault, when Dr. P. . . ., who had addressed the patient, imbued, even with excess, with the necessity of impeding the edges of the nasopalatine opening with nothing, made him lower this plate. The opening cicatrised very promptly; but as our young confrere remarks with reason, is this to the absolute defect of contact of the plate and the edges of this opening that it is rea-

* See the works of Velpeau, Vidal de Cassis, &c.

† This practitioner has published many works upon our art, among others, a *Dissertation upon the Diseases of the Teeth*, printed in 1753, and reprinted in 1783; then a *Letter to Morton*, in 1784.

‡ Summary upon the Straightening, &c., followed by some Reflections upon Obturators of the Palate, by J. N. A. Schænge. Pamphlet in 8vo.

sonable to attribute this advantageous result? No, we reply with him, because all the accidental perforations which narrow and close take the form of a funnel. From whence it results that by giving to the obturating plate a depressed form, even simply horizontal, we increase the facility with which the nasal mucosities accumulate between it and the palatine vault, and impede the movements of the tongue; and that without any compensation as to the occlusion of the opening.

However that may be, we maintain obturators, *juxta-placed*, by ligatures surrounding on each side, the nearest tooth by prolongations, of a length proportioned to the extent of the obturating plate; but we renounced this method, because ligatures, ascending incessantly above the neck of the tooth and the gum, wounded the latter and loosened the former, and occasioned insupportable pain; we then had recourse to crotchets forming springs; and as the first had a tendency to slip up upon the teeth, like the ligatures, we soldered to one, and often to two points of their inferior border, another small crotchet, a kind of stopping pin, which in bending below rests upon the crown of the tooth, and prevents the principal crotchet from slipping as we have already many times said.

As all the teeth do not offer a sufficient surface to hold this stopping pin, some authors, amongst others Delabarre, and after him Lefoulon, have advised a groove to be made with a file on the side of the crown. We, ourselves, think, that it would be better to solder the crotchet to a small frame enveloping the tooth, as we have already shown in several instances; the teeth, in every case, and particularly in the one which we are now treating of, are too expensive to have their solidity compromised by any means whatsoever, and for a still greater reason by a loss of substance for which there is no necessity. We have applied many obturators constructed in this manner, and we have had them commended for their adjustment and solidity.

If obturators, *juxta-placed*, have this great advantage over obturators *introduced* of presenting no obstacle to the occlusion of the division of the palatine bone, it must also be acknowledged that they neither favor or aid this occlusion. It might

in the case where the division, resulting from some disease which affected only one point of the palatine bones, leave them in relation upon some other points, and thus render it an absolute impossibility for them to unite except by the meeting of the edges of the opening. But as we have said at the commencement of this article, the division of the palatine bones does not always result from an accident which may be limited by perforating them, these bones are very often altogether separated from each other, and this separation, generally congenital, coincides often, we know, with a division either of the lips, or with the veil of the palate, as in the case of the patient who became the subject of the interesting discussion between Blandin, Velpeau and Gerdy, and of which we have given some of the most important points. It is in this case that obturators should not be confined to filling the opening, without placing an obstacle to its occlusion, but they should directly favor this occlusion. Unfortunately science, it is to be regretted, has no means capable of filling this last indication ; for, as Blandin observes, with reason,* “that which opposes the success of staphyloraphy in the case of the division of the palatine, is this division itself and the state of separation in which the soft parts are held.”

“Also,” adds this practitioner, “an important service may be rendered to the unfortunate effects of this defective conformation, by proposing a method which may at an early period narrow and obliterate the cleft of the palatine vault. We may thus change a *complicated* into a case altogether *simple*, in which the operation most frequently succeeds. Levret, Jourdain and Antenrieth have endeavored to fill this indication ; Roux has attempted the compression of the dental arches from without inwardly.” To these names Blandin might have added those of Le Blane,† of Quesnay,‡ of Desault,|| and even of Dupuytren.§

* Dictionary of Medicine and Practical Surgery, vol. xv, p. 17.

† Summary of Surgical Operations ; vol. i, p. 25.

‡ Journal of Medicine ; year 1773, vols. xxxix and xl.

|| Surgical Works ; vol. ii, p. 205.

§ Oral Lesons, published by Marx and Briere of Boismont.

What methods have these authors employed for exerting this compression? All which our researches have taught us in this respect is that Levret and Antenrieth have exerted a compression upon the lateral parts of the jaw, that Jourdain exerted a double traction in contrary directions upon the two ranges of molar teeth; that Roux, after being in conversation with Miel and making several experiments with him, had entrusted to a mechanic whose name he does not mention, the care of fabricating an apparel appropriated to this usage, but of which he gives no description.

Finally, Vidal de Cassis* simply expresses himself thus in this respect: "We may aid nature by a compressive bandage acting under the two cheek-bones, or by metallic wires traversing the palatine vault, and binding the molares on the opposite side. If these means are well supported, they will abridge very much the time necessary for its union." That which is nothing more than the procedure of Jourdain, who wrote when he was sixty-five years of age, with this difference, however, to the credit of this master in our art, that he used silk and not metallic bands, for good reasons which have escaped the attention of Vidal de Cassis; "1st, that this wire might injure the teeth; 2nd, that if it is fine gold, it will loosen in extending; 3rdly, this hard body, touching the tongue or rubbing the gums, might wound them."†

Desirous of responding to this honorable appeal made by Blandin to our art, we have imagined for this purpose many apparels free from the hurtful action of all ligatures applied upon the teeth which they do not fail to loosen. The first is a band of platina, or of palladium, which is still harder, carrying an obturating plate, then exactly adapted to the palatine vault in a transverse direction, and proceeding from each side, bent upon the teeth to a level with the alveolar arches; but in such a manner that the descending branches, resulting from each curve, far from being applied upon the portion of the palatine vault, and the alveolar border to which they corres-

* Work quoted, vol. iv, p. 195.

† Work quoted, vol. i, p. 451.

pond, are separated from them by a distance proportioned to the widening of the bone which we wish to draw together. Then, its extremities are pierced by a hole intended to receive a vice, which, put in rotation, moves before it, or rather from without inwardly, a plate placed upon this arch, and pressing upon it to a sufficiently great extent.

This apparel seems to us, at first, to have the inconvenience of injuring the internal part of the jaws by the inevitable projection of the vice intended to perform the pressure. We substitute for it another, which acts, on the contrary, no more in compressing the dental arches, but in drawing them together. In order to accomplish this, the apparel was placed interiorly, and composed of an obturating plate in the middle of which a clicking pivot was fixed, which, turned by means of a key, would draw to it two pieces proceeding from each side, to embrace exteriorly the dental arch as the plate upon which the vice of the first apparel exerted their pressure.

These two apparels, as we see, exerting an effort, which increases only each time that we make the vice turn a step in the first, and the pivot in the second, acting by saccades, and not as it is to be desired in every case where we wish to force an organ from its place, by a gradual but slow and continued tension.* From a knowledge of the fact that a division of the palatine bones which frequently accompanies congenital hare-lip, is effaced by the simple compression, which is then maintained united, at first by needles, and then by their cicatrization, exert upon the whole of the anterior part of the maxillary, we seek a method which imitates, as nearly as possible, nature in this action. The following are the two methods which we have adopted.

The first consists, simply, in enveloping all the anterior part of the superior alveolar arch in an elastic steel-band, whose two branches, furnished with leather, or, what is still better, India-rubber, acting by their continued reaction nearly as Dupuytren represents, who aided the action of the lips by means

* See that which we have said on this subject in our chapter devoted to dental orthopedy.

of two compressed cushions against the jaw, maintained by two metallic springs around the cranium. But the application is painful, because the difficulty of overcoming its elasticity in adapting it to the mouth, increasing, of necessity, in proportion as its extremities advance, its progression becomes painful and even insupportable, before having exactly embraced the whole of the alveolar border, for which it is designed. It has, besides, the inconvenience of pressing upon the gums, so much as to make us fear that mortification may result from it. We, consequently, seek an easier method, which we will now describe.

We constructed a palatine obturator, filling exactly the whole palatine vault, and fixed to the teeth by three crotchets soldered upon each side so as to encap the canines, the two small molares, and, also, the two large ones, then bent it upon the alveolar border, which would protect it from all effort. This palatine plate being well adjusted, we divide in two from before backwards, and we remove from it on each side, so that the edges would remain separated from each other about a finger's width. We then replace that which we had removed from the halves of platina by a thick and resisting band of India rubber, a little smaller than the space which separated the two halves and to which we solidly rivet it. The apparel, making as before but a single obturating plate, was no larger, as we see, than may be necessary for the crotchets to surround the teeth to which they should be attached.

But by means of two bent bands, proceeding transversely from one of the demi-plates where they were rivetted to hinge, to the other where they were received into a small screw-ring, the plate would cover the necessary space by the tension of the India-rubber. The apparel was then placed in the mouth. Once well adjusted, we make the bands with crotchets leave their screw-rings, and we remove them by means of a turn-vice; the India-rubber, ceasing to be distended, then shrinks upon itself, and, in this re-action, draws necessarily from without inwardly the alveolar arches by an action altogether similar to that which the lips, in the healing of their congenital division, exercise upon the palatine bones against which they

had for a long time made a violent pressure. We are as much more induced to believe, from the result of this action, that Roux* thinks that the union of the veil of the palate, by the operation of staphyloraphy, might alone affect the drawing together of these bones.

The principal action of this apparel resides in the tension of the India-rubber, we might replace the extensive screw-rings, which never offered a great solidity, at least as the plate was not forced in the place where they were screwed, we might replace them, we say, by a metallic band which, a little larger than the India-rubber one, might be received in the groove under this latter in order to give to this plate the necessary size. This plate once placed and properly fixed, we withdraw the band, which would cause the elastic band to return upon itself and accomplish the desired end. We might force this apparel by placing first one of its sides upon the teeth, then by extending this band to the necessary degree in order to make it enter the other side. Finally, as the India-rubber band distended and placed in an atmosphere constantly warm, might soon lose its elasticity, we would in time be obliged to replace it by another.

Nevertheless, in a sum total of these different apparels, the action of the first could be most relied upon, first, because it is so simple, then, because of its great force. It is, also, the opinion of professor Lisfranc, to whom we have submitted them, and who has wished us to promise to give a description of it on the first occasion. However that may be, that which is of particular importance, is that the action of the instrument is felt upon the alveolar border, and not upon the teeth which loosened, and even completely removed.

Maxillo-palatine Obturators.

In combining that which we have previously said of maxillary obturators, with what we shall say of palatine obturators, we may construct the *palates* or *plates of palates with dentures*. We are content to indicate these pieces,

* See page 76 of this Treatise, already quoted. French edition.

leaving to the mind of the dentist the care of conforming to the multiplicity of cases of this nature which may present themselves to his observation, and which would each demand a particular description, if we had not under our eyes so curious an example of it, which we think we should relate.

It is of a young man at present a wine merchant, at Paris, who, being in a military regiment, then in Africa, had been taken a prisoner by the Arabs, and had had the whole left side of the superior jaw fractured by blows from a butt-end of a musket. All the bone, too, to which the large molares were attached dropped out, carrying with it the superior parts which prolonged in front under the cheek bone, and that which, in curving within, formed at the same time the palatine vault and the floor of the nasal fossæ.

The piece that we made for this young man, sustained by many crotchets, embracing largely the teeth which they surrounded and which some bent pins upon the triturating face prevented them from injuring the necks, was formed of a single metallic plate divided in two parts; one, *active*, a true obturator, very convex, was applied on the left side upon the palatine perforation which it hermetically filled, was bent upon the alveolar border which it exteriorly embraced; the other part, *passive*, or a simple support, covered the posterior face from all the right dental range, to the molares to which they were intimately united by crotchets.

In the place corresponding to the loss of substance was applied a piece of hippopotamus upon which the absent teeth were drawn, furnished with their gums; this piece was maintained by two pegs soldered to the plate and rivetted upon the triturating face of the teeth. The two parts of this piece was left free, by the curve which their assemblage offered, an interval large enough, for the sense of taste to be exercised; an important precaution which it is always prudent to take in the adjustment of pieces of this nature.

We might, as we readily perceive, remove from this apparel the anterior portion of the plate which bends behind the right teeth, and unite simply its obturating part by a transverse band with a frame which might surround the opposite mo-

lares ; this would be much easier to execute, but less solid, because we would necessarily deprive it of the support which the anterior teeth furnish.

There is still a case which should be mentioned, it is that where a palatine opening, needing an obturator, is desired by a person whose superior jaw is completely deprived of teeth. How can it be maintained in place ? This is a question which would require to be solved all that which we have said of double or complete dentures, whose superior portion is maintained by springs attached to the inferior. To obturators of the kind of which we are now speaking, two springs should be fixed, such as we have described, and they should be attached to a band or metallic cap enveloping the posterior teeth of the inferior jaw, at least if the patient does not prefer a complete superior denture, to which an obturating plate should be fixed. This denture should always, as far as possible, be mounted upon a metallic base which harmonizes better, under all relations with this plate. By one of these methods every rational indication might be filled.

The strange form, which the accidental openings by which the mouth may communicate with the nasal fossæ, may offer ; the various complications which may accompany them, as disorders following them at the same time or a distant period in the dental apparel ; the varied nature of the causes under the influence of which they are declared, are sufficiently foreseen, as the mechanical means appropriated to their occlusion are those whose construction offers the most difficulties and requires the most precaution and skill on our part.

Summary of the Principles and Rules which should always serve as a Guide in the Combination and Adjustment of Pieces.

Those who intend practising our art, will find, doubtless, in that which we have said upon dental prosthesis a rule applicable to the plurality of cases and principles, whose study would serve as a guide in the course of a career which is most difficult to fill worthily, which does not seem to be gen-

erally believed, and point out those shoals that experience alone will, unfortunately, teach them how to avoid.

But they will deceive themselves if they hope to find means adapted to every case, under all circumstances, because there are not two patients to be met with in perfectly similar conditions, and that, upon twenty individuals requiring our aid for the same object, each would demand, perhaps, a modification of details, or a particular combination, either in size or form, consequently the dentist is obliged to depend upon his own judgment and ingenuity.

This would not be the case if all would limit themselves in this important part of our art, to the pure and simple fabrication of instruments of prosthesis. With some anatomical knowledge, however summary, we may always combine pieces sufficiently well to imitate organs whose result is to replace the loss and fulfil the functions of the natural organs; for as in sculpturing, we have only to study the forms in order to copy them. The various difficulties appearing at the moment when the piece is ready to be put in relation to the living parts, and consequently irritable, whose sensibility has to be considered much more, since it is rare that they are free from diseases, sometimes so serious as to occasion losses which it is necessary to repair; diseases which are as frequently the result of a constitutional vice as of a local or accidental nature.

A medium intelligence, a glance assuredly, a slight knowledge of the means which the imitative arts employ, and that which we ordinarily term a little taste, will in effect suffice for the fabrication of them; but the study of the various points of the sciences of precision, particularly of mechanism, assisted by physiology, and reduced by practice to fixed principles, become necessary to combine the adjustment of pieces and to maintain them solidly in the place they should occupy.

With ideas furnished by this study, how shall we determine rigorously the power and manner of using wires, crotchets, springs and other mechanical agents intended to maintain pieces in this state satisfactorily in an equilibrium which destroys the effect of their weight and prevents their traction and

rubbing? how can we arrange these pieces in such a manner that they will follow the movements sometimes so brisk of the inferior jaw, without ever abandoning the often irregular plane which this movable lever offers; and in such a manner that they will touch the teeth of the opposite jaw, without occasioning a shock which might loosen their supports and thus cause them to fall?

If, however, persons who have resource to our profession for the replacement of some part of the denture would call upon us a short time after the loss of this part, we could at least overcome the difficulties inherent to our art, without having to combat them that results from the disease which caused it, and which happen in the majority of cases. But for the small number sufficiently sensible as not to support the inconveniences of a difficult mutilation, but easy, however, to remedy, how many others yield only to the most painful necessity, and wait, expecting that a long and painful inconvenience, will render them insensible of the loss. Then the adjoining parts, having if one is permitted to say so, contracted new habits, taken new relations, experience when the artificial teeth are introduced into the mouth at once, a kind of repugnance, which might result in a brief torture when the piece was small, but which might even extend to pain when the piece was large, and for a still greater reason, when it consisted of a whole denture.

Pain is not the only inconvenience that follows this torture, then, put suddenly in contact with foreign bodies, which press upon them, inflame, swell, and often become excoriated, and this purely local pathological condition may give rise to morbid phenomena, very often sufficiently serious to alarm, and, unfortunately, always sufficiently serious to authorise doubts upon the forethought of our art, the power of our resources, and the perfection of our products. How often have we seen persons complain to us of pieces, besides perfectly made and properly adjusted, and accuse the dentist of unskilfulness and ignorance, who had often no other detriment, and which is sometimes a very great one, then not having warned the patient of the pain which would undoubtedly follow, or having promised more than it was possible to obtain.

We know, then, that in frequently removing one piece, in order to immediately replace it, we should have only one end in view in constructing it, and in condescending to the wishes of those who wear them, but of gaining time; for this time engenders habit, and habit, it is not necessary to dissimulate, is to us an important auxiliary. It is even important, in the most of circumstances, that the work should be so ably combined, that the patient may easily remove it himself, so as to allow the parts upon which it rests, or which supports its repose, and whose sensibility alters insensibility by their new contact; which, however, takes place more certainly and more quickly, we repeat it, in proportion as the parts are in a better state of health when the piece is placed.

From thence this double difficulty, which a long experience and profound study of pathological shading may alone teach us to avoid; placing these pieces so soon that the neighboring organs may not have time to contract new habits, whose destruction will be always difficult and often painful, and of deferring their application to so late a period that the diseases which the loss occasioned, may be entirely cured. Persons who have recourse to us rarely, unfortunately, determine the proper period, and address us for reasons of which the health is far from being the most prominent.

Young practitioners most frequently yield to the sound of these difficulties which we have mentioned, and from this precipitation the most serious accidents often result. A fact related by Taveau* proves this, which he does not fear to give for this praiseworthy reason, "that science may profit as much by errors as fortunate cases, and that there is as much merit in candidly avowing the first as in promulgating the second."

A marine officer presented himself to him in order to have the six lower anterior teeth replaced, whose fall, according to the assertion of the patient, took place without their being much decayed. Our honorable confrere did not find a sufficient contra indication in the swelling of the gums, which he attributed to the habit the patient had of smoking, made a

* Work quoted, p. 307.

piece, which the first day appeared to be well adjusted, but it soon rendered the gums so inflamed and painful, that it could not be supported for at least a month.

This person again calling upon Taveau, he questioned him more closely than he did at the first interview, and, from the details in which they entered, he discovered that the teeth were lost under the influence of a scorbutic affection which still existed. Taveau advised him then to seek the advice of a physician and to temporarily remove the piece. This advice was taken, and, six months after, he with all certainty of success, applied another piece, composed then, not of six teeth, but eight, the two first molares having, in consequence of the suppuration of the alveoli and other morbid phenomena, which followed in the course of the treatment, undergone the fate of the first six.

The dentist should always be ready to know that, if some persons support with pain, they exaggerate the momentary torment which is nearly always experienced in the first period of the application of a piece, and make no effort to overcome it; others, also, and it is nearly useless to say that these are particularly women, dissimulate completely this pain by the desire of experiencing no delay and no interruption in the enjoyment of the advantages which they expect from them.

We saw about three years since, a foreign lady, whose age and education might have warranted her from a similar fault, pay for, by the most serious accidents, the obstinate refusal that she avowed to her dentist, a noble and experienced man, the pain that she experienced from a pivot intended to solidify a large piece of denture, but introduced in a root, whose sensibility had not been sufficiently appeased. More recently still, one of us was obliged to remove for the wife of a farmer in the department of the Seine and Oise, a piece of denture which had been placed some days previous, whose pain had been dissimulated, but which had exerted grievous reactions and determined serious accidents.

In every case, before commencing a piece, we should carefully examine the mouth of the person, and thoroughly notice the manner in whether it closes and whether the teeth cross or

correspond. We have, sometimes, much trouble to obtain this result, without which the adjustment of a piece is impossible. Some in the inferior jaw advance or recede, whilst others cross the superior in front. We have seen some persons among whom this vicious disposition (the inversion) was natural, seek to correct it by persuading the dentist to take the impression of some large spaces to fill in their mouths. We have already observed this fact in treating of dentures or complete pieces.

The foresight or experience of the dentist should be sufficient to recognise these errors and to arrange all things in the true relations which should exist between them; these may nearly always be accomplished by requesting the patient to bite naturally, and to apply the teeth squarely and correctly in the mouth, *the only method* of judging, with precision and certainty of its true method of closing.

Notwithstanding all these precautions, a dentist who has placed a piece of many teeth, often is altogether disappointed at the result, although he may have previously taken his precautions and measures, so as to be certain that the closing of the mouth would be impeded in no way by the teeth of the artificial piece. In this case, when he is well convinced, after the remembrance of the inspection and primitive study that he has made of the mouth of the patient in taking his impressions, that the difficulty in the occlusion of the teeth or the simple trouble of it was not the fault of the piece, but of an involuntary contraction, or a spasmodic one of the muscles of the jaw, he should not trouble himself or take any account of this new method of closing the mouth, but try the piece again the next day.

Then he will perceive, with satisfaction, the advantage of the advice we have given of delay, for the parts having assumed their natural relation, the mouth will close properly, for the simple reason, that the person, thinking no more of his piece, will find that the jaw has neither shrunk nor augmented. We have seen some dentists of little capacity, we say it with regret, shrug their shoulders, in order to make those believe to whom this has happened, that pieces made by others

than themselves, were badly constructed, and that, without certain dispositions which they would have given, and corrections which they should by all means undergo, they would never be able to wear them.

We should endeavor not to embarrass our patients, or worry ourselves, if we would popularise this idea, that it is not useful to expect that a jaw should be deprived of all of its teeth to be supplied with a large piece of denture, particularly the superior jaw, because it suffices, sometimes, to include a single tooth skilfully in one of these pieces, in order to prevent it from deviating and from rubbing, which these so often occasion for want of support. The weight of a piece is often the only method of preserving an isolated one, which having no support, or exposed to a multitude of efforts, (particularly on the part of their antagonists,) which they, with difficulty, resist; which sustained, on the contrary, may last a long time and render a great service.

We have proofs of this every day. The most recent one was furnished us by the wife of a distinguished advocate of the bar of Paris, who, having long since lost the four incisores and the four small molares of the inferior jaw, had the two canines entirely isolated, and rendered loose by the continual shock of their antagonists. Believing that it was impossible to place a piece without extracting these two teeth, this lady had supported a long time, with resignation, the precocious mutilation that her mouth had undergone, when, better informed of the resources of our profession, she applied to us. We made her a piece, arranged in such a manner that the two teeth which remained were perfectly enclosed and sustained, but altogether free from the shock of those of the superior jaw.

A month had scarcely passed before this piece needed some slight repairing, and this lady was astonished to find that the two isolated teeth had not only received no injury from this piece, but that they had, on the contrary, received great solidity from it. Doubtless, if more teeth were scattered here and there, the dentist would have more difficulties to overcome; but this reason, which is only a question of time and labor,

should never frighten the intelligent and honorable dentist, who should always make it a case of conscience never to destroy a single tooth in order to simplify a construction or adjustment of a piece, particularly if this tooth is healthy and presents no obstacle to the solidity of the piece.

In regard to the complaint that is often made of artificial teeth because of their disagreeable odor, it is only owing to the *bad adjustment* of the piece, and to the neglect of the person who wears them to clean them properly. The dentist should then establish the most perfect contact between the piece and the gums or supporting teeth, so as to prevent the introduction of foreign bodies, principally alimentary particles; and this should be accomplished even to the detriment of its appearance. If he is certain that this contact exists, he should seek to discover if the change of breath in the person cannot be ascribed to some other cause, if it does not result, for example, from some vice in the digestive or pulmonary organs, very common among women, and, in general, among the inhabitants of large cities, particularly in the easy classes.

But, as it is difficult always to obtain an exact contact, and rare that it can be long maintained, it is prudent for the piece to be frequently removed by the dentist, particularly if it is of animal substance, which we are aware is more easily affected by the buccal fluids. In order to do this, it is useful, even indispensable, to have a piece to change, so that the mouth may never be unfurnished, and so, that, if one is fatiguing upon some point, the other would not, probably, be so, and time might be had to rest this painful point.

It will be very easy, if one desires, to prove to persons who believe that this recommendation is not for *their* interest, that this increased expense is a true economy; for the piece would last a much longer time, if it is frequently repaired and properly cleaned. The manner in which this last direction should be accomplished, consists simply in rubbing it with a brush and soap-suds, but, perhaps, better with alcohol mixed with water, at least if it was not in a very bad state, and considerably affected with animal odor, which too long a sojourn in the mouth might cause, and if so, we should have recourse

to a very strong aqueous solution of chloruret of chalk. If the piece was entirely composed of mineral substance, (mineral teeth and metallic bases,) we should pass it through fire to clean it. We may, by this means, if it has not been fractured in some point, return it to its primitive state; nothing, consequently, can clean it so perfectly. It is not the same case with pieces, in the construction of which animal substances enters, particularly those with bases of hippopotamus: we see them, in a short time, worn in deep furrows by the buccal fluids, and become a cause of corruption by the retreat that these holes offer for alimentary particles. How can these pieces be repaired? Is it necessary, as Delabarre advises, to fill the holes with a kind of mastic composed of *sulphur* and sifted salt? It is easy to see that this kind of bituminous polishing never gives to the piece a united surface which is useful, whatever precaution we may take in heating the piece in order to facilitate the introduction of the cement in all the anfractures, and leaving no spaces.

But it would be better to reduce the depressions to true holes, and to fill these with pegs of hippopotamus, which we level with the rest; or rather to remove the changed parts, and cover them with a true veneering. But all these repairs constitute defective work; the dentist should, for the credit of his profession avoid them as much possible; BETTER OFTEN TO REFRAIN THAN TO BADLY ACCOMPLISH, a recommendation that we cannot too often give to our young confreres, who should make it a rule, and who should not at least apply to the primitive construction of a piece the various repairs which it may need.

It may be observed, from that which we have said, we profess a medium opinion, between Maury on the one hand,* who thinks *that artificial pieces should never be removed, even to clean them*; and Lefoulon†, who makes an exception of *complete dentures*; and on the other of Delabarre‡ and Taveau,|| the first of whom believes, *that it is advantageous to displace*

* Work quoted, p. 328.

† Work quoted, p. 352.

‡ Work quoted, vol. ii, p. 469.

|| Work quoted, p. 310.

them frequently ; the second, that it is not only useful, but indispensable to remove them every day.

To the first, we object, because there are certain accidental positions, whether diseased or not, which, rendering the gums all at once tumid, as is the case in simple fluxions, and, as we have frequently seen, for example, among females at menstrual periods, place their precept often in fault, by imperiously demanding the removal of the piece ; to the second, we would remark, that the more we remove a piece, however well made or properly adjusted, that we loosen the supporting teeth, and injure the solidity of those which this piece should support, as we have often seen, and of which we will give examples at a convenient opportunity.

We conclude, then, that nothing can be absolutely established on this subject, and that all principles emitted, *a priori*, that is to say, in the formal designation of the conditions of their application, may be contested. Nevertheless, the obligation one is under of removing, from time to time, pieces of artificial denture, comprises, by all means, palatine and maxillo-palatine obturators, an obligation which had not escaped the observation of ancient moralists,* and to which the particular method of attaching and fixing dentures or complete pieces permits to sacrifice at pleasure, does not apply, we expressly say it, that those which are attached by pivots, at least if the roots upon which these pieces are implanted are not changed, or the substance forming the pivot, or simply its setting, in a state of decomposition. It is not then, as we see by the exception, necessary to remove them in order to clean them, but only when we wish to repair them.

Apart from these two circumstances, which are on the one hand, the alteration of the supporting root, and on the other the decomposition of the pivot if it is of wood, or of its setting, if it is metallic. Pivot teeth which offer the type of solidity,

* "*Nec dentes aliter quam serica, necte,
reponas.*"

"Each evening thou should'st remove thy teeth, as thy robe."

Martial, Lives ix, p. 38.

and, particularly, of the simplicity of our means, may last many years without forming the least disagreeableness, or demanding any more care than that which we daily give to the mouth. We will not return to these different precautions to which we have given all importance, and devoted one of the principal chapters of the first part of this work; the desire of avoiding repetition, and of saying nothing which is not absolutely useful and even indispensable, obliges us to close here.

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