H W C Boedecker

A TREATISE ON THE

IRREGULARITIES OF THE TEETH

AND THEIR CORRECTION

INCLUDING, WITH THE AUTHOR'S PRACTICE,
OTHER CURRENT METHODS.

DESIGNED FOR PRACTITIONERS AND STUDENTS.

Illustrated with nearly 2000 Engravings.

[NOT EMBRACING THOSE IN THE THIRD VOLUME.]

BY

JOHN NUTTING FARRAR, M.D., D.D.S.

GRADUATE OF JEFFERSON MEDICAL COLLEGE, PA., AND OF PA. COLLEGE OF DENTAL SURGERY; MEMBER OF NEW-YORK COUNTY MEDICAL SOCIETY; MEDICAL SOCIETY OF THE COUNTY OF KINGS; INTERNATIONAL MEDICAL CONGRESS, IX.; NEW-YORK CITY DISTRICT DENTAL SOCIETY OF THE STATE OF NEW-YORK; AMERICAN DENTAL ASSOCIATION; BROOKLYN DENTAL SOCIETY; HONORARY MEMBER OF AMERICAN ACADEMY OF DENTAL SCIENCE, AND OF WISCONSIN STATE DENTAL SOCIETY; FORMERLY LECTURER IN PENNA. COLLEGE OF DENTAL SURGERY; MEMBER OF NEW-YORK ACADEMY OF SCIENCES, AND OF THE METROPOLITAN MUSEUM OF FINE ARTS, NEW-YORK.

VOLUME I.

NEW-YORK CITY.
1888.

FOUR TYPES OF ABNORMAL DENTAL ARCHES.

Jumbled Arch.

Saddle-Arch.

Protruding Arch.

V-Arch.

RK521
F24
V.1

COPYRIGHTED, 1888,
BY JOHN NUTTING FARRAR.

All rights reserved.

To my Classmates, and
Professional Friends,
I dedicate these Volumes

J. N. Farrar

TABLE OF CONTENTS.

VOLUME I.

PART I.

PART III.

ON THE ETIOLOGY OF THE IRREGULARITIES OF THE TEETH.

CHAPTER IV.

CHAPTER V.

CHAPTER VI.

CHAPTER VII.

CHAPTER VIII.

CHAPTER IX.

PART IV.

PHILOSOPHY OF THE AUTHOR'S SYSTEM.

CHAPTER X.

CHAPTER XXX.

PAGE

THE LONG-BAND.

CHAPTER XXXI.

CANTILEVER DEVICES.

CHAPTER XXXII.

DEVICES FOR TURNING TEETH.

CHAPTER XXXIII.

KEYS.

PART VII.

RETAINING DEVICES.

CHAPTER XXXIV.

UPON RETAINING DEVICES.— GENERAL REMARKS.

CHAPTER XXXV.

CHAPTER XXXVI.

RETAINING PLATES.

CHAPTER XXXVII.

RETAINING PLUGS.

PART VIII.

LABORATORY RULES FOR MAKING REGULATING DEVICES.

CHAPTER XXXVIII.

CHAPTER XXXIX.

CHAPTER XL.

PART IX.

PHILOSOPHY OF THE APPLICATION OF FORCE.

CHAPTER XLI.

CHAPTER XLII.

CHAPTER XLIII.

CHAPTER XLIV.

PART X.

ERUPTION OF TEETH.

PART XI.

ANTAGONISM OF TEETH.

PART XII.

CORRECTION OF TEETH BY GRINDING.

CHAPTER LII.

ANTAGONISM IMPROVED BY GRINDING.

CHAPTER LIII.

ABNORMAL RELATION OF THE JAWS.

CHAPTER LIV.

ANTERIOR DISPLACEMENT OF LOWER JAW.

CHAPTER LV.

ANTERIOR DISPLACEMENT OF LOWER JAW FROM WANT OF ANTAGONISM OF SIDE TEETH.

CHAPTER LVI.

POSTERIOR DISPLACEMENT OF THE LOWER JAW.

CHAPTER LVII.

NON-OCCLUSION OF THE ANTERIOR TEETH.

PART XIII.

CHAPTER LVIII.

INTERDENTAL SPACES.— THEIR CAUSES.

CHAPTER LIX.

ON THE MOVING OF TEETH TO CLOSE INTERDENTAL SPACES.

CHAPTER LX.

PHILOSOPHY OF LATERAL MOVEMENT OF CROWNS AND ROOTS OF TEETH TO CLOSE INTERDENTAL SPACES.

CHAPTER LXI.

PAGE

VARIOUS OPERATIONS FOR CLOSING INTERDENTAL SPACES.

PART XIV.

EXTRACTION OF TEETH FOR PREVENTION AND CORRECTION OF IRREGULARITIES.

CHAPTER LXII.

EXTRACTION FOR PREVENTION AND CORRECTION OF IRREGULARITIES.

CHAPTER LXIII.

SUPERINCUMBENT TEETH.

CHAPTER LXIV.

EXTRACTION OF DECIDUOUS TEETH TO PREVENT IRREGULARITIES OF FORTHCOMING LATERALS, CUSPIDS AND BICUSPIDS.

CHAPTER LXV.

THE FIRST ADULT MOLAR.

CHAPTER LXVI.

CUSPID VERSUS LATERAL.

CHAPTER LXVII.

IRREGULAR CUSPIDS AND INCISORS.—WHICH, IF EITHER, SHOULD BE EXTRACTED?

CHAPTER LXVIII.

WHICH BICUSPID TO EXTRACT IN ORDER TO MAKE ROOM FOR IRREGULAR AND OVERCROWDED CUSPIDS.

CHAPTER LXIX.

PAGE

EXTRACTION FOR CORRECTION OF IRREGULAR LOWER INCISORS, CUSPIDS AND BICUSPIDS.

CHAPTER LXX.

EXTRACTION FOR CORRECTION OF NON-OCCLUSION OF THE ANTERIOR TEETH.

VOLUME II.

CORRECTION OF IRREGULARITIES OF THE TEETH BY MECHANICAL APPARATUS.

PART XV.

CORRECTION OF INDIVIDUAL TEETH.

PART XVI.

TURNING TEETH IN THEIR SOCKETS.

PART XVII.

ELEVATING ARRESTED TEETH.

PART XVIII.

WIDENING, ELONGATING, AND ENLARGING THE DENTAL ARCH.

PART XIX.

PROTRUDING TEETH.

PART XXV.

LEVERED FERULES.

PART XXVI.

METALLIC SPRINGS.

PART XXVII.

SCREWS.

LIST OF ILLUSTRATIONS

IN VOLUME I.

FOOT-NOTE FIGURES NOT NUMBERED.

PART I.

Preface.—Preliminary Chapter.

PREFACE.

WHEN a child I soon learned that the strongest attraction in the house was the table-drawer, for in it could be found odd ends and scraps of almost everything that had been in the family for years. Every garment and ornament belonging thereto in the past had here its representative in some "left over" scrap; every toy that the children had lost, every unused button, string or pencil found its way thither through the careful hand of one who knew the occasional value of such trifles. Here was a museum in a nutshell, in which I was reminded of many forgotten things, and in which I found keys that unlocked store-houses of information of early-day trials and victories that otherwise might never have been given me. Even grandfather's knee-buckles had their story to tell me of the quaintness of his costnme. But it was many years before I learned that in the "table-drawer" chapter at the beginning of a book was usually to be found a collection of facts concerning the history of the book quite as interesting and instructive to the reader as the miniature museum was to me. It is said by those who read most widely and most intelligently that the reader who omits this chapter will lose sight of many bearings of the questions under discussion, to be seen between the lines only. Whether this be true or not, I trust the reader will not find the time given to perusing this preface and the following chapter disadvantageously spent. The nature of the work will be better understood from a brief account of its origin. I therefore ask a patient hearing of a few explanatory statements.

In this Treatise I have aimed to make my views especially clear, not only to correct current erroneous impressions, but also to place the results of my experience before the profession to whose welfare and progress I have striven to contribute during the best years of my life.

When I began to practice, principles, methods and even suggestions in regard to regulating teeth were meagre. The apparatus in use was crude, clumsy, uncleanly and painful. During later years, however, the number of mechanical aids (devised by the profession) has increased; a few have been successful, but many failed. An attempt to show where success left off and failure began would not prove, however, that the mechanical principles adopted in their construction were perfect on the one side, or that they were altogether faulty on the other. Success depends as much upon manipulative skill in the use of tools on the part of the manufacturer as on the principles themselves. Invention to me has always been a diversion, not a labor, therefore I found enjoyment in this occupation; and when I succeeded in making, among various instruments, devices that seemed to be an improvement on the established forms of regulating apparatus, I thought it no more than right to describe them for the benefit of others. Numerous as these devices were, however, some that were constructed to surmount special difficulties, I regret to say, are now lost and forgotten, because of the many new and different mechanisms that have subsequently suggested themselves.

At that time I had no intention of writing on the subject, nor did I propose to indefinitely continue, even after I had begun to publish articles in the professional journals. Perhaps this diffidence arose from a desire to avoid provoking a prejudice in the public mind by a too vigorous advancement of new views. But being unexpectedly encouraged by the profession, one paper after another upon different phases of the subject was added, until an extensive series was formed. Being scattered through many issues of the journals, requests for their publication in book form became frequent and urgent on the plea of greater convenience of reference. Considering the hasty and imperfect style in which these papers were written, there was reason to feel some professional pride and gratification in such appeals.

At the time this collection was called for, a desire was also expressed that a course of lectures upon Facial Expression, Beauty and Harmony, which I had delivered before college classes in 1878, and repeated during several successive years, should accompany them.[1] Swayed by this kindly encouragement, I had a growing inclination to write at some distant day a work to be posthumously published, notes for which I had already jotted down, and for this reason I remained undecided as to the expediency of then collecting in book form the papers and lectures mentioned. Thus the matter stood until 1884, when, being prevented from active practice by a long illness, it occurred to me that the wishes of my professional friends had not been complied with, and that perhaps waiting for the distant day of leisure in which more time might be devoted to the matter would prove fatal to the project, for the carrying out of which I was encouraged by the increase in number of those who had adopted the views which I believed would ultimately be accepted by many others. I therefore looked over and

---

[1] These lectures on Esthetics as applied to Dentistry in the main were extracts from an unpublished work, entitled "Talks about Teeth," which I wrote in 1875. In substance they constitute a portion of Part XXI., in Vol. 2, of this work.

arranged my notes to see how far they would contribute to the formation of such a work, which I resolved to begin as soon as possible; and, even before convalescence, I had put the task under way.

As most of these papers were constructed to serve a double purpose—namely, to set forth some esthetic or theoretic principle, and to illustrate the application of the same to practice—it was found that an arrangement of the subjects in proper order would render it necessary to divide and transpose many portions or to reconstruct them altogether. It soon became apparent that this mode of procedure might prove unsatisfactory, especially if the dates of publication and the references to the original papers in the journals were to be preserved. Arrangement according to this method was, however, attempted; but it soon became evident that to preserve the exact text would diminish the value of the work, by preventing the introduction of additional suggestions. To overcome this difficulty, I thought that by interposing new chapters and making foot-notes from the manuscript jottings intended for the posthumous work, the broken threads of the subject might be connected. For a time this seemed to suit the exigencies of the case; but the plan did not long satisfy me. It was therefore abandoned, and the entire work reconstructed according to the original plan intended for the posthumous work, preserving in foot-notes the dates and the places of publication of some of my papers, and indicating my inventions and improvements by placing the letter A, standing for "author," at the end of the inscriptions under the illustrations. The reader who compares this work with the original papers will see that, although the views and suggestions advanced and the variety of operations recorded in the former are far more numerous, the principles of theory advocated, are alike. In this way these volumes were begun and completed under adverse conditions arising from overwork at professional duties.

To hint, much less assert, in this day of progress, that I have gone over the ground of this subject so thoroughly that improvement is impossible, would be absurd. These volumes are simply the exposition of conclusions derived from a personal experience of twenty-four years, jotted down in odd moments and written out at intervals extending over a period of fifteen years, at hours which are generally devoted to sleep. The work has, however, been revised to the latest date before going to press.

While mention has been made of the many flattering encomiums pronounced upon my views as advanced in the journals, these eulogies were, of course, the expressions of believers in my theories. At that time there were many who did not agree with me; but now I incline to believe that by far the greater number of the profession accept the theory of the agency of physiological law and the philosophy of the system as a whole, though some still urge that I have greatly overrated the importance of the former. Of the older and honored heads, however, there are still a few altogether opposed to what they are pleased to call "newfangled notions," and who are even opposed to regulating teeth by any plan or system, declaring it to be an interference with nature. A remark made in my hearing at a meeting of a Dental Society, during a discussion upon the subject of Correction of Irregularities, may serve to illustrate the opinions of this class. "Now, gentlemen," said the speaker, "it's all very well to talk of the wondrous things that some people can do, and that too without a single failure; but I have tried all the plans, and can't make any of the traps stay on the teeth five minutes; and I know from experience that it is better to let nature alone and not bother with crooked teeth. God made them so, let them alone." After shrouding the subject in a thick fog of misrepresentation, making trivial things throw colossal shadows and senseless rumors swell to alarming proportions, he relieved the audience by sitting down.

Differences of opinion are natural. As the opinions of people vary upon all subjects not belonging to exact science, it would be strange if in this matter there should be uniformity of belief. Opinions do not alter truth; facts are facts; and although words may sometimes so mystify as to delay its acceptance, yet in the end truth is generally triumphant.

The confounding of different phases of the system—the law governing the physiological functions of the tissues, and the plans of the mechanical devices necessary to take advantage of these functions—has caused a confusion of ideas in some critics concerning the principles advocated. To a conservative mind that does not fully understand the basis of a doctrine, it is quite natural to "fear that the underlying principles are not altogether correct." Similar criticisms were made concerning the views of Prof. Morse at the time he urged the value of the electric telegraph; but the wheels of progress were not stopped, and the few who accepted his views lived long enough to be benefited by them and to see them universally established. It is far from my desire to resent the criticisms of those who differ from me, for most of them are personal friends; but, since the criticisms have been made, and some of them are published, justice to the profession, if not to myself, demands that they be mentioned, and such of them answered as are worthy of a reply.

A prominent dentist, who says he has had nearly fifty years of experience, though little in the line of regulating teeth, made the amusing objection in a public meeting, to the author's system that it made his head ache to study it.

Another, evidently ignorant of the great number of devices described in the journals, not to mention the greater number described in this work, implied that the author had absurdly claimed that all regulating operations could be performed with one piece of apparatus. One person, having acted upon the erroneous statement of a writer that a certain form of clamp-band (used by me only as an anchor-band for the attachment of other devices) is "adapted to the rotation of single teeth," and finding by trial that it was not adapted for turning, condemns the entire system. Another speaks as if the screw and the system were the same, and that because the screw is old, "the system itself is not at all new," losing sight of the system in the mechanical auxiliaries employed to carry it out. Still another regards the system as superior, but "useless in general practice on account of the great degree of skill necessary to construct the apparatus," as if the same argument would not equally apply to plate and to "continuous gum" dentures. Some object on the ground of expense, a matter at which I do not think any operator should hesitate, so long as he can thereby be enabled to do the work with less inconvenience to the patient. One writer on regulating is extremely zealous to have my practical experience appear limited, and asserts that the apparatus I describe never existed, that my cases have been purely ideal—in short, that the appliances, if made, were fanciful and impracticable. Those who know the facts can attest that the appliances have been in constant and daily use for years in a very extensive practice. Another says: "If the subsequent or main part of an operation be made so easy by the use of fixtures constructed on the positive plan of mechanism that patients can conduct most of the regulating process at their homes, especially if they can do it with little or no pain, they will not only fail to appreciate these advantages, but will be unwilling to remunerate the dentist adequately for his skill." Seemingly to cause prejudice against the results of experimental investigation concerning absorption of tissues under pressure, it has been confidently asserted that to attempt to ascertain the rate of tissue change caused by pressure, so as to state it as a mathematical law, "no matter how broad, is absurd." It is said that "a habit of detraction often asserts itself in criticism by simply declaring that what the critic dislikes is absurd." I think it is Darwin who, in his Preface, says that "Ignorance more frequently begets confidence than does knowledge," and that "It is those who know little and not those who know much, who positively assert that this or that problem can never be solved by science." The better nature is understood, the more apparent I think it becomes, that laws underlie all her actions and that these laws are all, more or less, mathematical.

As to the question of pain in dental operations it has been asserted that "Most of the trouble in such cases comes from the suggestions, either in words or manner, of the operator himself, who puts into their heads the idea of pain, which they accordingly feel in excess." Indirectly referring to the same point, an author says: "So far as pressure itself is concerned, it is immaterial whence it is derived; the same weight, force, or power will produce the same result. What source shall be employed is a matter of convenience only."

If these opinions regarding pain were well grounded, I should feel that I had missed one of the aims of the years of toil consumed in writing this work. But the cries of the many who have suffered tortures while undergoing the regulation of teeth by the old method of using strings and elastic rubber must have reached the ears of the dentists; and I cannot think that any large majority of them believe either that the pain is imaginary, or that it is "immaterial" whether or not we use the material or the character of force that causes it.

No further reference to these criticisms is necessary, as they speak for themselves, and some of them "carry their own antidote." For the same reasons, it is unnecessary to more than mention that there are still a few persons, claiming to be "conservatives" (but, who, I regret to say, too often appear to be far behind in the wake of progress), who attempt to place the stamp of their individual prejudices upon the whole profession, by asserting that "the principles underlying the author's system have received only limited support in the profession." Yet a reply may be in order to one assertion that has been made by the same hostile critics, who have placed themselves in a delicate position by attributing to me opinions which I never held. They endeavor to put themselves in a different light by representing that I have changed my views. The opinions that I now hold are the same which I have held ever since I began to write upon regulation. These views will be found, fully explained, in PHILOSOPHY OF THE AUTHOR'S SYSTEM, pp. 134–196.

The increasing cordial support that has been shown to me, on every hand, in Europe and America, from year to year, while I have been engaged upon this treatise, has been a great aid and benefit to me. If, in turn, my work shall prove to be, equally, an aid and benefit to professional brethren in their labors, and to my younger readers, by stimulating them to thought and investigation, I shall feel thankful to those who encouraged me to write it, and shall, moreover, regard myself well repaid for the many years devoted to its preparation.

J. N. FARRAR.

NEW YORK CITY, April 24th, 1888.

PRELIMINARY CHAPTER.

HAVING briefly shown in the Preface, why this work was prepared, it now remains for me to explain *how* it is written. This will only be attempted in a general way. A simple outline of some of the most salient features will be presented, leaving the details to be found in the body of the Treatise.

Although primitive dentistry has been treated of in various technical works, and especially by French authors, the question of Regulation is in many not even alluded to, in others is barely touched, and in all is regarded as distinctly subordinate to hygiene of the teeth and only important as affecting antagonism or guarding against overcrowding. Fitch, writing in 1839, gives a catalogue of over four hundred works on dental science, but all the instruction on regulation given in them might easily be contained in one volume of very moderate size. Nor, except in a few works, have the broader views of later writers yet found expression, being in the main contained in journals, and in reports and transactions of societies. In fact, the proper time does not appear to have arrived for writing a work covering the whole topic in concrete form ; and that time will not arrive until some mooted points are better settled and some truths more generally accepted. Until then, whoever attempts to advance new ideas or to more firmly establish truths already advanced (but still obscured by the fog of doubt), must expect to meet with opposition. Yet it would be wiser to welcome each new worker in the field; for, it is by individual effort that the paths of knowledge are opened. It is by experiment that certainty is attained, and by the collation of the evidence of many, that theory gradually becomes the basis of scientific operations.

One of the cardinal principles, especially advocated in this work, is the importance of the observance of the physiological law which governs tissues, during a movement of the teeth (by means of art), the object being to prevent pain. To insure this result (exemption from pain), the pressure by which the movement is to be effected should be under the control of the patient, a requirement which implies the use of instruments capable of being operated and adjusted at will. By this the maximum rate, at which it is possible to move teeth painlessly, can be ascertained. But while the system expressly advocates the use of "controllable" mechanism, and of intermittent force, when practicable, the assertion made by hostile critics, that the use of continuous force, is wholly disapproved of, under all circumstances, is untrue.[1]

The idea of taking advantage of the functional laws of the tissues to prevent pain, appeared to me (at the time of its conception) novel, and yet so rational that, when fully appreciated, it would be available in general surgery as well as in dentistry. To determine this rate and test its value, I made a series of experiments which extended over a period of several years. The results were made known to several professional gentlemen in 1873; and in February, 1874, this topic was the subject of my graduating thesis at Jefferson Medical College, and afterward

[1] See author's remarks in "Dental Cosmos," January, 1876, p. 21, last ¶, Jan., 1878, p. 18, 2d ¶, and July, 1888, p. 396; also, Report of International Medical Congress, IX. (1887), Vol. V., p. 573–4.

read in the main before the Brooklyn Dental Society, April 12th, 1875, and published in the Dental Cosmos, January, 1876.[1]

This work contains many facts already known to the profession; it also contains those of my views that have been made public through the journals; but, as the conclusions at which I have arrived, after more deliberate thought, appeared to me interesting, I believed that a fuller exposition of them might render them interesting to others. Therefore I have dwelt at considerable length on some points where popular belief seems to be greatly at variance with mine. But in doing this I have endeavored to show a spirit of liberality.

Old Methods.—Little can be said in favor of the old-fashioned methods of moving teeth by means of elastic rubber or strings, in connection with heavy and cumbersome plates; yet for the sake of a large though apparently decreasing number of the profession, considerable attention has been given to the description and explanation of a few of such devices, but more is said of the lighter and more convenient forms of mechanism made to act upon the same principles.

I followed the old methods in my practice for a few years, and, like others who did so. I caused so much pain to patients that they fretted much, and were thankful when the operations were over. Knowing that the sting of failure is worse than the smart of pain, I felt justified in using the only means then understood, but I was determined to persevere until I should arrive at better methods; for I do not believe that to the patient the memory of pain is ever wholly obliterated, or that such experiences can ever re-

---

[1] Several months after the publication of this paper in the Dental Cosmos, it was plagiarized by an essayist, but the plagiarism was soon discovered and exposed through the journals.

dound to the credit of the operator. Now that the possibility of pain or failure is in great measure removed, practice has acquired a wholly different aspect. To be sure, the apparatus recommended, even if perfectly made, sometimes slips off when patients do not follow instructions, and thus causes pain, and apparatus improperly planned, imperfectly constructed, or unskillfully applied, is very liable to failure; but these failures are not to be attributed to the system.

When I first made the broad statement that the screw was capable of being used in more forms than that of the screw-jack, and that the screw might yet be made to play an important part in the correction of nearly all conditions of irregularity, the assertion was proclaimed by many to be absurd. Even the screw-jack, now admitted to be adaptable to many conditions with wonderful results, was then thought capable of very limited service.

Perhaps this condition of opinion and the changes that have since taken place may be well illustrated by quotations from Dr. N. W. Kingsley, who, in Johnston's Miscellany, February, 1877, p. 41, a year or more after I began to publish papers on the subject of regulating with screws, says: "The jack-screw can be regarded as first in importance, only because it possesses greater power; but its application is limited." He further says in the same paper: "I never use jack-screws except in connection with a plate." But three years later this hostile critic, formerly the pronounced advocate of plates, elastic rubber rings, and strings, writes in "Oral Deformities," p. 69, 1880: "The screw is one of the most valuable adjuncts at our command in regulating teeth. On its first introduction it seemed a cumbersome apparatus, taking up valuable room in the mouth, interfering with mastication and articulation, irregular in its movements, requiring constant attention and liable to injure the teeth by impinging and wearing upon them. It was a common idea that the pressure on the teeth, for their safety, must be moderate, uniform and uninterrupted; the action of the screw could be neither uniform nor uninterrupted. But experience has demonstrated its safety and its wonderful adaptability. By it a narrow arch of the most refractory character can be made to yield, and with it almost every movement we desire can be accomplished."

Professional Progress the Object in View.—While these pages are principally devoted to setting forth my methods of practice, I do not at all assert that the methods of others are without value; for many are very meritorious, and to some people are preferable to more valuable ones, because less expensive. Even the old plan of using elastic rubber, stretched here and there among the teeth, has its place, especially in cases of young children. In truth it may be said that all plans have their merits, so far as merely accomplishing the movement of teeth is concerned. For this reason many of the devices that I use with small children, and many which I formerly used for adults, as well as the best devices of others, are mentioned and explained.

If there is one point which I especially desire to have well understood, it is that my object has not been, nor is it now, to destroy old methods, but to improve them, or at least to contribute to that end, and introduce new and better ones. It must be admitted by all that the greater the number of devices publicly explained, the greater will be the stock of aids from which the young dentist may select, and the greater the encouragement for him in turn to invent still more useful appliances; and whether he believes in the philosophy of physiological acts or not, the results will be the same if the operations be conducted as advocated. But, on the other hand, to those who feel that the principles of the system are sound, and, I think, that they will (in time) be so conceded by the majority of the rising men, these various aids will have a greater value and the operations will be much more encouraging.

An additional benefit naturally following a published description, with the dates of these hundreds of mechanical inventions, is the balking of imposition upon the profession attempted by some people in securing Letters Patent for devices to which they are not entitled. Understand me : the recording of dates is not for the purpose of preventing people from obtaining patents for things that they originated, but to prevent the restraining by patents of the use of the inventions of others, who have, through a love of the science and the welfare of the dental profession, given them free to all. If these improvements contain even some principle that will suggest a new and useful idea to others, even if it be merely to aid in the construction of a somewhat different but valuable device, it is worth while to mention them in this work, so that, in the future, there may not be claimed a right of invention that will restrict their use.

I have especially commented upon several essential points which seem to me to have been overlooked by other writers. Some of these remarks are for the purpose of correcting the impressions formed by erroneous traditional teachings, and some for that of reviving undeveloped but evidently important truths. I have also tried to set forth clearly the reasons of success and failure in operations. I claim that the *failures* are not always to be found in the circumstances of the case, but sometimes in the want of capacity in the operator. So important do I regard an understanding of this point, that I have drawn attention to it more than once in the work.

Methods of Teaching.—What the best method is of teaching the arts and sciences, so as to stimulate thought, is a question of opinion. There are some who believe in progress, which everybody knows implies new things and new ways; and there are others who believe that to move on in "the good old way" is best. Mr. Walter C. Bagehot, in the "Fortnightly Review,"[1] remarks that history refutes the idea that progress is the normal desire of all human society, and Sir Henry Maine, in "Ancient Law,"[2] says that the greater portion of mankind never manifest the least desire to have their civil institutions improved. If this be true it will readily be seen why the hindering clamor of the many retards the progress of the few, and that to lay out a plan of advance in scientific pursuits, as well as in political and religious directions, that would be beneficially received by all, is not possible. Some of the advanced thinkers of the past have been called by people of their time "visionary" and even "crazy," for example, Columbus, Stephenson, and Fulton. Especially was it so with the last mentioned, whose early attempts to construct a steamboat were ridiculed as "Fulton's folly." Even some persons, who were sufficiently intelligent to accept his theory as scientific, joined in the abuse as if the possibilities that might grow out of the new idea, if nourished, never dawned above their mental horizon. It is an encouraging fact, however, that in the dental profession the number of these non-progressive spirits is small compared with those which foster advance; and it is because of this fact that this profession has made so much progress in the last twenty-five years, and seems destined to advance still further.

Some believe that there is a definite plan of teaching dentistry which is always best, without regard to difference of circumstances; as if all things could be proved to all minds by the same test. Even if circumstances were

---

[1] April 1, 1878, p. 452. [2] 1861, p. 22.

always the same with regard to the patient, a difference in the capacity of the operator, as before stated, might render the highest order of manipulation impossible. One dentist finds that he can regulate teeth successfully by one plan, and another by a different plan, the degree of success depending much upon the skill of the operator. Some believe that only cheap, simple and rude devices should be used; other teachers even advocate using these exclusively, and declaim against the employment of anything complicated because difficult to construct, regardless of the fact that to some persons construction presents no difficulty. I once visited the class operating-room of an institution where such were the teachings, and where I observed with regret the lamentable failures resulting from them.

To some minds (it appears) the most beneficial plan in a work is to present a detailed account of office cases from the profession in general, as well as from the author's own practice, while others think that, putting aside the liability to the criticism of being actuated by personal motives in presenting a compilation of one's own office cases alone, a better plan is to teach philosophical principles as a foundation, because such instruction naturally leads to an easy accomplishment of better results. The former method is like beginning to learn geometry at the conclusion of the book; the latter is beginning with the first and simplest proposition, and going forward step by step to the more difficult.

I am aware that such accounts of office operations are valuable to students, yet I cannot ignore the fact that "cases in practice," although sometimes interesting, are so various in their nature, and so large a number is required to include all phases of difficulty, that an attempt to present a sufficiency would be confusing to the reader. A clear knowledge of principles is absolutely necessary to thoroughness, and as thoroughness is essential to enable the operator to grapple more easily with difficult cases, I have endeavored to mark out a course with this end in view, giving especial attention to philosophical principles that will include and extend beyond the range of average operations, supported by what I believe to be a sufficient number of typical cases to illustrate the more important phases. By the teaching of principles I do not mean merely explaining in a general way the several fundamental laws of mechanics as given in school books, but pointing out in a somewhat didactic manner definite methods as well as the principles of the methods; and by autographic sketches illustrating how to apply them in various ways, and calling attention to the fact that seemingly trivial differences in apparently similar cases may sometimes require a considerable difference in the construction and application of devices, and in the manner of treatment. Some of these autographic sketches are hastily drawn, but are sufficiently graphic, I trust, to enable the reader to understand the particular points which they are intended to illustrate. Indeed they are probably more intelligible and instructive than if they were drawn by a person unacquainted with the art of correction of irregularities. These sketches as they now stand constitute a portion of the text.

The above remarks are not intended to imply that judicious quotations from other writers detract from the value of a scientific work, even if it should consist largely of such quotations. An author who attempts to write a scientific work containing only his own conclusions, must necessarily lose much that would sustain him. The views of other writers coinciding with his own strengthen and support him, and even a statement of radically different views increases the interest of the readers from the fact that the book embodies the ideas of more than one person.

In an original work, however, there is a limit beyond which quotations weaken the interest of the reader.

In the matter of regulating teeth, the chief difficulty to many dentists lies not so much in determining what movements of the teeth are needed, as in devising and making apparatus for bringing about these movements. To aid in this matter, a large part of my work is devoted to an explanation of different plans for constructing apparatus suitable for every class of irregularities. The illustrations are drawn from devices actually made and in use, not from imaginary ones, as has been asserted by a devotee of "the good old way." Besides the above-mentioned illustrations the work is enriched by several wood engravings, for which I am indebted to the kindness of publishers, J. W. White, W. C. Barrett, C. W. Spaulding, George Watt, Geo. P. Davis, W. T. Keener and Johnson & Lund.

As a result of adverse popular opinion concerning several vital questions, though less pronounced at present than at the time of the first publication of my views, and of the antagonistic spirit of a few members of the profession, some of these chapters are written in a more argumentative style than they otherwise would have been. In portions of the work, in treating some subjects upon which there seems to be a lack of general information — as, for illustration, Harmony and Art—I have enlarged upon some phases more than is the usual custom, extending the boundaries to include a broader view ; this with the object of stimulating some of my younger readers to deeper thought concerning their bearings upon the science.

All operations upon teeth were first made empirically, without any attempt to study the laws governing vitality, and then men waited to see if nature would tolerate them, but the attempt to make truth subservient to expediency is rapidly becoming obsolete. To discover truth and act according to its laws, is the order of the day. Nature is now assisted when she desires it, as illustrated in the use of medicine, and forced to accept aid when she does not, as in the practice of surgery; and finally the question of securing the convenience and comfort of the patient has come to be regarded as worthy of consideration. The method of accomplishing this has in a measure been learned by experiment. We learn even from our failures. Failure is a strong evidence either of defective knowledge or defective means, more so than success is a measure of ability. To know that we don't know, is said to be strong evidence of wisdom. I do not mean by this, however, that failures are necessary to develop ability. As a rule, if the laws of nature are better understood by one operator than another, their manipulative skill being equal, the former will be the more successful in his efforts.

In repeatedly calling attention to the deeper scientific aspects of the different questions introduced, the object is to aid in rooting out errors from the mind, which I believe can only be done by persistent effort, just as perseverance is necessary to destroy weeds of rank growth. Experience shows that the majority of human beings are so willing to retain the erroneous doctrines once learned, that to lead them in the path of true progress generally requires repetition in order to open their minds to the truth, so that they may accept and use it. This, in our different ways, I think we are all bound to do—not to be content to move along in present conditions, but to try to climb higher.

Question of Priority.—Although the devices herein described, with the exception of those accredited to others, had, so far as I knew at the time of inventing them, no previous existence, I have avoided making pronounced claims. I do not assert that the principles involved in some of the devices may not have been known to others.

While the principles used in all machinery are old, a variation in combining them or an addition constituting a highly improved as well as a wholly different machine, may sometimes be denominated an invention. An improvement may seem trifling, but if it makes that practicable which was before impracticable, it can no longer be regarded as "trifling." Mr. Howe made the formerly useless sewing machine a success by merely placing the eye for the thread near the point of the needle.

Touching this question of priority in invention or construction, it has been my desire to give credit where credit belongs; and while I have endeavored to do so, I am obliged to admit that in some instances the evidences are so meagre and in others so conflicting that I may not have been able to do justice to all. Much must be left to proof; for he who makes an improvement in method or machine, and has not sufficient public spirit to announce it, has but little claim for general sympathy in the matter; nor can the public be blamed for hesitating to believe that which is unsupported by proof, offered through the press or otherwise. Everybody knows that mankind is prone to tell of new ideas, methods and inventions, if it has any; and everybody knows that it is easy for some people to make assertions and claim the credit of inventions after they have become known.

Scope of the Work.—This work would have been finished much earlier had there been some accepted classification of subjects to serve as a guide. The difficulties encountered in writing for the first time may perhaps be appreciated when it is considered that, prior to 1874, very little had been written upon regulation, and that was of a miscellaneous character. There had not been, so far as I know, any attempt to definitely classify mechanical devices; no nomenclature indicating the position of teeth; no classification of expression for individual teeth, nor of types of the arch; little definite concerning harmony between the facial expression and the arrangement of the teeth; no clearly marked differentiation of the principles adopted in manufacturing appliances, nor any differences recognized in the character of force; no mathematical demonstrations of the philosophy of action and reaction in the bearings of the apparatus on the teeth; no accurate demonstration of the effect of irregularly developed teeth upon undeveloped ones nor upon their sockets by the process of regulating; no definite explanation as to the action of the alveolar tissues under the influence of the different kinds and degrees of force; nor any clear statement as to the difference between moving teeth by causing absorption and moving them by taking advantage of the flexibility of the alveolar tissue. Above all, the fact that pain may be avoided with certainty by conducting the operations within the domain of the physiological functions of tissues was wholly unknown.

It is the custom of authors in dwelling upon special points to refer the reader frequently to other pages of the work instead of repeating. I do not, however, regard the convenience derived from the reiteration of an item a trifling matter, but as being so great a convenience in saving the reader the trouble of hunting through other chapters that I have preferred to repeat the passage unless too long. Of course such repetition need not necessarily be a verbatim reproduction; it may be not only varied to avoid monotony, but also extended so as to include additional ideas.

I had designed incorporating in the present publication a few chapters upon several other phases of the subject. Although they are partially prepared, the book has already grown to dimensions so far beyond my original intention, that I have decided to reserve them for future publication, possibly for another volume of this work.

In writing this treatise, I have aimed to avoid the use of many words and terms in vogue that do not properly express the meaning intended, and in their place have adopted those which seem to me more pertinent. In arranging the chapters I have followed the order that naturally suggests itself. Beginning with History, followed by Etiology, I have rapidly proceeded through the successive changes of later development to the simpler cases of irregularity, thence to the more difficult; at the same time explaining what are thought to be the best plans for correcting each. This I have attempted to do by arranging the varieties in something like order. In other words, I have endeavored to write in such a step-by-step manner that the student already familiar with the elementary stages may easily understand the subject. Another phase of the arrangement is a classification and explanation of the principles of the various devices in use, after which is given an approximate classification of cases, with the operations and the different kinds of apparatus that have been found practicable for performing them, so that the reader desiring information on any special subject, whether as to mechanism or as to cases, can easily find it.

The work is divided, for the convenience of the reader, into several parts. The first volume deals with the History and Etiology of the subject; the Basal Principles of Regulation; Nomenclature; Principles of Construction of Apparatus; Retaining Devices; Laboratory Rules for Manufacturing Devices; Application of Force; Eruption; Antagonism; Interdental Spaces; Correction of Irregularities by Grinding, and by Extraction.

The second volume contains the Classification of Irregularities and the various methods of Treatment for Correction; Straightening Teeth to Line; Turning and Elevating Teeth; Widening and Enlarging the Dental Arch;

Correction of Protruding Teeth ; Miscellaneous Suggestions, practical and theoretical ; and lastly, the Esthetics of Dentistry.

As will be seen, these volumes are quite different in their general character. The first presents the basal principles of the subject, and deals largely with the philosophy of the application of force, and the construction of the mechanical devices for applying it to the teeth. The second gives a classification of the various forms of irregularity and shows the application of different kinds of apparatus for the correction of each, beginning with the simpler operations, and proceeding to the more complicated and difficult. The second volume also contains, besides considerable general information useful to the student, collected under the head of Miscellaneous Suggestions, an entire Part devoted to the artistic phase of dentistry, a portion of the work which may be regarded interesting and valuable as dealing with the possibilities to which the profession may reach when mechanical skill, as now shown in the art of preserving teeth, will be surpassed in appreciation by the artistic talent shown in reshaping and beautifying the face.

The third volume is wholly pictorial, being an object-index of all mechanisms described in the other volumes. In Vol. 2, the diagrammatic order is governed by the locality and kind of operations, but, in Vol. 3, classification is made according to the principles upon which each mechanism is constructed ; for illustration, those that act by springs are in one class, those acting by screws are in another, etc. A bird's-eye view of all enables the operator to quickly select whatever he desires. The inscriptions, under the figures, indicate where the mechanisms are explained. In the third volume are, also, several figures of modifications and variations of devices not shown, elsewhere, in the work.

PART II.

History.

CHAPTER I.

BRIEF HISTORY OF DENTISTRY, INCLUDING THE DEVELOPMENT OF THE ART FOR CORRECTION OF IRREGULARITIES OF THE TEETH.—B.C. 3100–2700.—B. C. 1800–1400.—DENTISTRY IN ANCIENT EUROPE.—PHŒNICIAN AND ETRUSCAN ANTIQUITIES.—B. C. 750–400.—RUSSIAN ANTIQUITIES.—B. C. 600–300.

AN observant dentist cannot long follow his profession without noticing that the teeth are not fixed organs; that they can and do move about, and although varying in their lines of travel, their slight, almost imperceptible, motion is continual. Besides the movements back and forth occasioned by mastication, they often wander into strange places and assume strange attitudes. The observer also notices that the loss of a deciduous tooth is often followed by the righting of a successor that has shifted to one side of it, and that in old age the lower front teeth, after the bicuspids and molars are lost, sometimes lean forward so far as to cause a corresponding protrusion of the lower lip; he also notices that, if an adult tooth is lost, those which are left sometimes scatter and stand alone or move toward the vacant place. Even when several teeth remain in a row, not only the one nearest to the gap will lean toward it, but sometimes it is followed by the others. Although the latitude of movement is not great, they are continually changing their inclination under the influences of various circumstances. Sometimes antagonism causes the changes, sometimes badly fitted plates for artificial teeth push them out of line, and in other cases they drift from unassignable causes.

Having noticed the spontaneous movement of teeth, it is not wonderful that some one in the past conceived the idea that if teeth can move of themselves, desirable changes might be made by applying force to them, and, moreover, that if natural changes take place at all ages, teeth could be regulated at any time of life. When and by whom teeth were first regulated, history, so far as has been discovered, fails to relate, but that efforts were made as early as A. D. 1541 there is no doubt, as will be seen by referring to an account of that period (Chapter II.).

B. C. 3100–2700.—While the art must have grown out of such simple efforts as extraction, the process by which the method was developed can only be inferred from circumstantial evidence through knowledge of the status of medicine, a brief account of which will be given to show the character of the evolution that led to it. From the early history of medicine we learn that the mouth received special consideration, and its cleanliness often constituted the subject of a religious command. Especially was this so in China. It is believed on good authority that the Chinese excelled in medicine at an earlier date than any other race. About the year 3100 B.C. the Emperor Chennong composed a creditable work on Materia Medica; and about 2700 B. C. the Mongol Emperor Hoangti wrote another work, called *Soo Wán*, on medicine. These works contained many instructions as to the requirements of hygiene, which included cleansing of the mouth. From this time forward various books were written, showing that the art had attained a considerable degree of excellence, until about B. C. 238 to 210, when, under Chi-Hoang-Ti, who had very little respect for any scholars except astronomers, the science of medicine declined, and has not since held the position it once did in

China. In India, however, it was studied as early as the eighteenth century before the Christian era.

B. C. 1800-1400.—The *Ay'ur Veda*, the oldest Hindoo work on medicine, is supposed to have been written some time between 1800 and 1400 B. C. According to Sir W. Jones, this work ranks next in antiquity to the five books of Moses. But if the present chronological arrangement by biblical scholars be correct, the date of the "Ancient Fragments" is B. C. 1320-800 (the Ten Commandments belonging to the earlier date, 1320); the "Book of Origins" was compiled in Babylonia about B. C. 536-458; and the date when these were collected by Ezra and Nehemiah (constituting with Deuteronomy and Joshua our present Pentateuch) is as late as B. C. 445. If this chronology be accepted, the *Ay'ur Veda* belongs to the century preceding even the earliest roll of the Pentateuch. This Hindoo work contains plates believed to have been made from actual dissections of the body, showing that among the Hindoos at that period the art of medicine must have been encouraged and cultivated. The Arabians studied the system of the Hindoos before the Greeks, but, later, foreign subjugation caused the science of medicine to decay among them. In order to enforce sanitary habits upon the people, the rules were embodied in the sacred works; these rules included, with other hygienic necessities, the cleansing of the mouth after eating. In biblical history there are general references to the teeth, which indirectly show the degree of importance they held at those early times, but these accounts are not sufficiently relevant to our subject to entitle them to consideration.

B. C. 750.—*Dentistry in Ancient Europe. Etruscan Antiquities.*—In pursuing his valuable and painstaking researches for evidences of prehistoric dentistry, Dr. Van Marter, several years ago, began to study the vestiges of the races of men which preceded the Romans on the Italian peninsula. These people, the Etruscans, once a great and powerful race, far advanced in civilization, science, and the arts, have been extinct for many years, probably about two thousand. One of the localities fruitful in discoveries of Etruscan relics is the city of Corneto-Tarquinius, near Civita

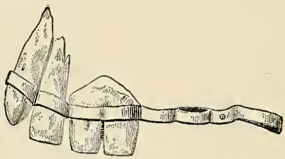


FIG. 1.—Etruscan Artificial Teeth. B.C. 400.

Vecchia, on the Mediterranean coast. Here Dr. Van Marter was given rare opportunities for inspection, and describes some of his discoveries substantially as follows: "It was beneath the ruins of one of these Etruscan tombs that the partial denture illustrated in Fig. 1 was found. As will be seen by the drawing, No. 1 represents the side view of an arrangement for holding in position two upper artificial teeth, by banding them to adjoining natural teeth. In this

FIG. 2.—Bottom View of the Denture.

case the right cuspid and lateral incisor were natural teeth, while the two central incisors (united) were evidently carved to fit the space, from the tooth of some large animal. Fig. 2 illustrates the bottom view of the same, showing that probably the other extremity of the band was held in place by the cuspid and first molar—the latter evidently stood in the place of the second bicuspid—all of which had crumbled to dust before the relic was unearthed. The cross-pin in the first bicuspid ring was no doubt placed there to rivet an artificial tooth to the ring. Whether the ring adjacent to the left central contained a natural or artificial tooth is not determined. The centrals were well carved and the denture skillfully made, considering the times.

Fig. 3 represents a partial denture which was taken from an ancient Roman tomb, dating back four hundred years B. C. The remaining tooth in this specimen, serving as a substitute, was evidently a human tooth, as was probably the missing one. It also illustrates the early Roman method of replacing two inferior incisor teeth on the Etruscan plan, which resembles a plan now practised and known as "bridge

Fig. 3.—Side View of a Partial Etruscan Denture, Lower Jaw, B. C. 400.

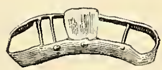


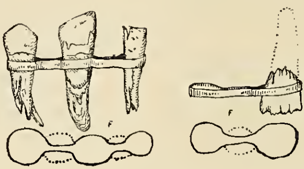
Fig. 4.—Bottom View of same Denture.

work." Fig. 4, the same case as in the last figure, shows a clear view of the position of the missing artificial tooth, and the manner of holding the same in position. The gold used in these specimens was very soft, probably made so for the purpose of more easily slipping the rings over the natural teeth, when adjusting the denture.

The latest Etruscan tomb that has been discovered in Italy (1886) was excavated at Capadimonti, near the Lake of Bolsena. The entire contents of this tomb were bought by an American dentist,[1] and presented to Dr. W. C. Barrett, and now constitute a portion of his private museum. The specimens in this collection more especially interesting to the dentist are a number of teeth of the prehistoric period, some of which are in a remarkable state of preservation;

[1] Dr. William Carr.

but in each of the molars there is a cavity from caries that must have existed when the individual was alive. Besides these teeth, there were three that were bound together with a gold band; also the crown of another (central), bound with a similar device. Figs. 5 and 6 illustrate the two specimens, and show the relation of the bands to the teeth in side view. In Figs. 7 and 8 the plain lines show the top view of the bands detached from the teeth as they appeared when I saw them. When in use, however, these bands were undoubtedly bent as shown by the dotted lines. These bands were probably bound to the teeth with gold wire, as shown in Fig. 9. The tomb contained other antiquities, a



Figs. 5, 6, 7, 8.—Etruscan Relics of Dentistry, B. C. 750-400.

list of which is given below, as evidences of the high rank held by the occupant of the tomb, and to show that consequently these specimens of denture were probably of the best that the period afforded. These articles were: two spiral gold rings; hair ornaments, curiously and exquisitely chased; one silver finger-ring; a necklace of lapis-lazuli and pure amber; a bronze wine-strainer; a silver *fibrilla*, or safety-pin; a bronze cup, with carved edges; a bronze cup elaborately ornamented, marked into eight parts by *répoussé* work; four earthen jugs, two of which are finely modeled; a bronze placque nearly two feet in diameter, having lions' feet and sea-horses standing in full relief; one large bronze vase, curiously ornamented, with ear-pieces representing the Taurian Jove; a bronze ornament, evidently an armorpiece for the head ; two vase handles, with carved head and tail pieces."

According to Von Helbig, this collection represents a period at least 2,600 years ago. It has at the present time no counterpart in this country, and in some respects no European museum can match it. . . . Without excepting some doubtfully authenticated Phœnician dentistry these specimens of early Etruscan dental work are the oldest now known to science.

Decay of Teeth not a modern Evil.—"These specimens prove," remarks Dr. Barrett, "that dentistry is one of the most ancient of professions; and the evidences of decay in these prehistoric teeth go far to disprove the notion that decay of the teeth is a modern evil, inflicted upon the race

FIG. 9.—Phœnician Dentistry. B. C. 600–400.

through modified and artificial food habits." According to Van Marter, "the early Romans learned their dentistry from the Etruscans, and if, as is generally believed, the Etruscans and Greeks learned all they knew of dental art and science from the Egyptians, we must trace this, like many other modern institutions, back to Egypt, the supposed mother of the arts and sciences." [1]

The specimen of Phœnician dentistry referred to above as of uncertain date, though very old, and said to be formerly in the Museum of the Louvre, at Paris, is illustrated by Fig. 9.

This example of early dentistry is described by M. Ernest Renan, in his work entitled *Mission de Phénicie et le Campagne de Sidon*, as follows: "But that which was most in-

[1] "Independent Practitioner," 1886.

teresting was the upper portion of a woman's jaws, showing the two superior cuspids and four incisors, united by a gold thread. Two of these incisors seemed to have belonged to another person, and to have been placed here in order to replace the missing ones." This piece, which if found as claimed in one of the most ancient vaults, proves that the art of dentistry was rather far advanced at Sidon, and also that the disease of the gums, *scorbut de terre*, so common in Sidon at the present time, existed in those days.

Whether the pure gold bands, encircling several loose teeth and bound to them by delicate wire passing between and around them, are evidences of early attempts at correction of irregularities, is doubtful. If they are, then the operation dates back to the sixth century before the Christian era. That they held teeth in line which were made irregular by looseness from wasting of their socket tissues is more probable, and that they served to hold dental substitutes in place there can be no doubt.

The written history of Dentistry in eastern Europe can be traced as far back as the time of Hippocrates, who lived in the fifth century B. C. He tells us that it was practised in his day; and discoveries made in the tombs built at that time prove what he says is true.

B. C. 600–300. *Russian Antiquities.*—An account of some of these discoveries was given by H. Eames, D. D. S., in the "Independent Practitioner" (May, 1886), from which we subjoin the following extracts:

"One of the earliest records of a dental operation is found upon a Scythian vase discovered in an immense tumulus or burial mound, situated about four miles to the westward of Kertch, a small town on the Crimean peninsula, at the entrance of the straits which join the Black Sea with the Sea of Azov. Historically, we know but little of the Scythians beyond the meagre facts recorded by Herodotus, but in the almost numberless tumuli which are found upon the Crimean coasts are preserved a most graphic record of their daily lives, manners and customs, in the funeral vases and other objects deposited in the final resting-places of their dead.

"About the sixth century B. C., a Greek colony from Miletus was founded upon the shores of the Bosphorus, and called Panticapæum. Constant communication was kept up between the colonists and the cities of Greece, and a great and powerful community arose, accumulating vast riches, introducing the unapproachable art of Greece, and adapting it to the uses of the nomadic Scythians as well as the more civilized people, who created what is known as Greco-Scythian art.

"The richest of the tumuli in relics was the Koul-Oba, which was a royal tomb. In a spacious apartment, constructed of large blocks of stone, were found the mouldering remains of a king, his queen or favorite wife, his servants and horses, surrounded by his treasures. The body of the king lay upon a superb couch composed of massive beams of carved and painted yew-wood, over which was a canopy. These paintings are purely Greek in character, and are perfectly preserved, notwithstanding that more than twenty centuries have elapsed since their execution. Near the splendid wooden sarcophagus of the king were the remains of a woman, doubtless his queen. On her head was a mitre-shaped diadem, and at her feet a small vase of electrum, upon which is embossed a frieze of characteristic episodes of Scythian life. Electrum, an alloy composed of gold with a fifth part silver, was highly valued by the Greeks, its color being paler and more luminous than gold. Upon the vase are four groups in exquisite *répoussé* work, giving incidents in the life of the same person. The king is clad in the Scythian costume, a tunic belted at the waist, and full trousers tucked in his boots; which is almost identical with the Russian costume of to-day. In one group he is listening to the report of a warrior kneeling before him, in another he is bending a bow, in the third his wounded leg is being dressed by an attendant, and the last, as before stated, is one of the earliest known representations of an operation in dentistry. (Fig. 10.) The king is half sitting, half kneeling, while the Scythian dentist is evidently "fixing" or extracting a tooth from the left side of the jaw. It

FIG. 10.—Scythian Dentist Operating, about 300 B. C. Copied from a Vase. (Eames.)

is reasonable to suppose that this represents an actual incident in the life of the skeleton found in this tomb. In the skull, now deposited in the museum at Kertch, the first and second left lower molars are missing, and the third molar is badly decayed. The presence of an alveolar abscess connected with these lost teeth at some period of life is shown by the condition of the alveolar process in this region.

"The only clue to the identity of the powerful monarch here entombed is an inscription of three letters upon an ornament; in these letters some scholars assert that they recognize the initials of King Pairisades, the son of Satyrus, who reigned about 310 B. C."[1]

---

[1] Much of this information was derived, says Dr. Eames, from a hand-book to the South Kensington Museum. Copies of some of the antiquities described in the above extract are on exhibition in the Museum.

CHAPTER II.

B. C. 460. HIPPOCRATES.—B. C. 384–322. ARISTOTLE.—B. C. 300. EXTRACTION OF TEETH. LEADEN FORCEPS.—A. D. 1. CELSUS, PLUGGING TEETH WITH LEAD.—A. D. 76. IMPLEMENTS USED IN POMPEII FOR FIXING TEETH.

HIPPOCRATES, who lived four hundred and sixty years before Christ, mentions among preparations suitable for dentifrices, some which he recommends for the purpose of "fixing" the teeth. As fixing the teeth was a term then used for applying artificial devices, such as the fastening in of artificial substitutes, banding, etc., before alluded to, it

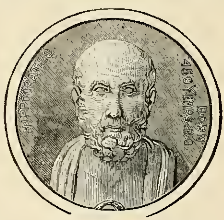


FIG. 11.—Hippocrates, 460 B. C.

is natural to infer that since dentifrices could not refer to this sort of "fixing," the word may possibly have meant something used for the purpose of cementing. Perhaps it meant filling cavities.

B. C. 384–322. *Aristotle.*—About seventy-five years after the period of Hippocrates, Aristotle appeared. This remarkable man was destined to be called the "founder of the science of anatomy." The Hindoo work, *Ay'ur Veda*, before alluded to, shows that an anatomist lived more than a thousand years earlier, but Aristotle is mentioned in history as the "Father of Anatomy," from the fact that he placed the science on a wholly different footing from that which it had occupied previous to his time. He also assisted in establishing the largest library of the period, the celebrated but ill-fated Alexandrian Library, lost in the days of Cæsar and Cleopatra.

From the time of Hippocrates to that of Aristotle, the science of medicine, although studied by several celebrated men, among whom may be mentioned Plato (B.C. 430–348), advanced but little, owing to the varying of their doctrines from the views of their great leader, but the acute genius and diligence of Aristotle, aided by the munificent support of Ptolemy Soter, worked wonders. It is said that Ptolemy expended $800,000 in aiding Aristotle to carry out his projects; and that he required his subjects in Asia and Greece to furnish the philosopher with birds, quadrupeds and fishes for dissection. With such encouragement the science of anatomy rapidly advanced. Nor was progress confined to this branch; nearly all departments of science owe much to Aristotle's brilliant intellect as well as to that of other great investigators. Heretofore, the travels of philosophers were so limited that they were bound up in sectarian notions and prejudices, but from this time forward they visited foreign countries, mingling with people of different nations who held various superstitions, until they were led to discard traditional fancies and found their views on the more solid basis of reason. While Hippocrates was very little enlightened concerning the nerves, Aristotle by his extensive dissections learned their true office; and although he appears to have studied them principally from the lower animals, yet he opened to the world a flood of new ideas on this subject.

That he did not understand the entire nervous system is not wonderful, since even at the present day it is not fully understood in all its offices and ramifications—for instance, that of the placental connection between the mother and child in utero. He speaks of the brain sending a vessel to the ear but no nerve, evidently mistaking the portio mollis for a vessel. He believed the heart to be the source of the senses, and that they were in no way connected with the brain. He observed no difference between veins and arteries, except that those connected with the aorta were more tense and fibrous than those connected with the vena cava, and he believed that the latter had no pulsations. Although he dissected the human body, he could not have acquired much of his knowledge of anatomy from it. Had he done so, he would not have maintained that the liver sent a vessel to the right arm, and the spleen another to the left, and that the treatment of the liver by bleeding should on this account be made from the right arm. Although he believed the heart to be the fountain-head of all the blood-vessels, singularly enough he thought the aorta did not send a vessel either to the liver or to the spleen. It is said by historians that Aristotle was the first to attach drawings to his works, but this is not true, as *Ay'ur Veda* contained illustrations. Even if this were not known, the statement would appear improbable, since the art of drawing came before that of writing.

Not many years after Aristotle lived, Proxagoras, a native of Cos, is said to have first explained to the world the true difference between arteries and veins; which, added to the explanations given by Aristotle, furnished a firm basis for further truth.

B. C. 300. *The First Extracting Forceps.*—In collecting materials several years ago for a history of dentistry from the time of Moses, which I brought down to the seventeenth century, I found that extracting forceps were probably unknown until 300 B. C., and that even then the extraction of teeth was regarded as being so difficult that surgeons seldom attempted it until the teeth were very loose. These forceps, which were deposited in the temple at Delphi, were made of lead. There is, however, strong evidence that, as a punishment, the hammer and spike were used at a much earlier date to knock out the teeth of enemies, which leads us to infer that the same plan was probably adopted to relieve friends from toothache, but it is natural to suppose

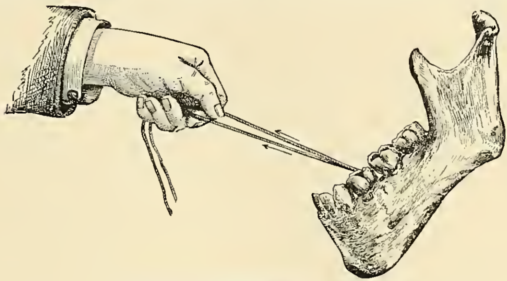


FIG. 12.—Method of Tooth-Pulling practised in all Ages.

that the string was used more frequently for "pulling teeth."

Belzoni, noted for his discoveries in Egypt, principally of antiquities of the fourth century B. C., informs us that, besides "ivory or wooden" teeth (found in tombs) fastened on gold, teeth were found that were filled with gold. Through the investigations of Dr. Van Marter, however, these various specimens, which for years were asserted to be gold fillings, have been found by removing the ashes to be not fillings but strips of flat gold and gold wire, bound around groups of teeth, as before explained, to "fix" them in position.

During the time of Aristotle, Alexandria became famous as the fountain-head of the philosophy and medical science of the period, but after his death, which occurred 322 B.C., nearly to the beginning of the first century before Christ, the *status* of the art of medicine in Egypt is said to have declined because research and experiment were practically prohibited, the penalty of death being inflicted on the operator if the patient died under his treatment. This caused the practice of medicine to fall into the hands of the priesthood,[1] and then diseases were ascribed to different spirits and demons, according to their nature, and thus "faith-cure" became a method of practice. Some of the claims advanced are too ridiculous to mention. Even in the present day, many members of the Latin Church believe that certain saints, relics or charms have power over some diseases; among these St. Barbara and St. Apollonia are said to have power over toothache, and St. Ottila over general ailments of the head.[2]

A. D. 1. *Plugging Teeth with Lead.*—When and by whom real plugging of cavities in teeth was first performed is not yet known. If "fixing teeth" mentioned by Hippocrates does not include filling, then it is possible that the assignment of this honor by some well-read people to Celsus, a Roman author, who lived about the beginning of the Christian era, may be proper; but Celsus leaves the question unsettled by simply advising the filling of decayed teeth with lead and other substances. This operation was called *plombage* (leading), and its object was to strengthen the "shell," so that it would not break down during the process of extraction. Although he does not clearly state that this filling was ever left to preserve the tooth, it is natural to infer that, as such filling could not be of any benefit for strengthening teeth, and as in those days of rude instru-

[1] Benson, Fonblanque, Sayce.

[2] See Pettigrew, "On Superstition," and Brande's "Popular Antiquities."

ments for extracting, some of the teeth filled in that way may have been left because they could not be extracted, and thus the temporary work became permanent,—the accidental result may have taught the value of plugging as a means of preservation.

A.D. 76. *Instruments found in Pompeii.*—While visiting a museum at Naples, I saw a set of dental instruments which were found in Pompeii. Being led by curiosity to examine them, I made sketches of several of them in my note-book. There were four varieties, and several sizes of each variety. A copy of these sketches (one specimen of each) is shown in the six following figures. These instruments consisted of forceps and tweezers of different patterns. They appeared to have been intended to be used as aids in

Fig. 13.—Dental Forceps found in Pompeii.

the use of wire or strings for binding loose teeth in line, so that they would be firmer; and also for the purpose of extraction by means of strings.

The largest instrument, Fig. 13, was a pair of flat transversely serrated beaked forceps, about eight inches in length, which, though smaller, resembled those now used by shoemakers for drawing the "uppers" over the bottom of their lasts. The beaks of this instrument, which were evidently made of bronze, were about one-fourth of an inch in width, and well calculated for drawing upon strings attached to teeth for extraction.

Fig. 14 illustrates another variety of forceps, an instrument about five inches in length. In the beaks were longitudinally fixed thin blades, having teeth which, when brought together, fitted between each other, like those in the jaws of a steel trap. Near the end of each blade was a hole, evidently made for a string or wire for adjustment about the teeth.

Figs. 15 and 16 illustrate different views of one of a variety

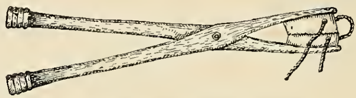
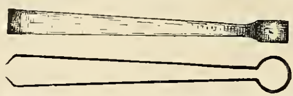


FIG. 14.—Saw-beaked Forceps (Pompeii).

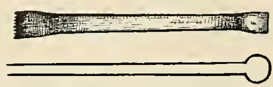
of tweezers evidently made of bronze, which were probably intended for adjusting strings or wire. These instruments resembled in form sugar tongs, and were thin as the handle of a silver teaspoon, they were from a quarter to a half inch wide, and from three to five inches in length, the edges at the ends being smooth. The following figures, 17 and 18,



FIGS. 15 AND 16.—Two views of Dental Tweezers (Pompeii).

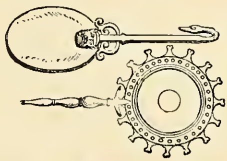
illustrate still another variety of tweezers apparently made for the purpose of forcing wire or string between roots.

From all appearances, as before mentioned, teeth were generally extracted at this period with strings adjusted by the tweezers, and drawn by means of the forceps shown in Fig. 13, or by winding the string about the hand (Fig. 12).



FIGS. 17 AND 18.—Two views of Dental Tweezers (Pompeii).

I noticed several round mouth mirrors with delicate handles, formed entirely in one piece of bronze or silver; the mirror portion was made by being highly polished, and the handles were ornamented and shaped to taste, some of which resemble those used at the present day. There were also Pompeiian hand-mirrors, made on the same general plan, some plain, others exquisitely wrought. I did not notice any specimens of these in this lot, but Figs. 19 and 20 illustrate two patterns of hand-mirrors found, among



FIGS. 19 AND 20.—Hand Mirrors (Pompeii).

some toilet articles, in a dwelling-house. These serve to show the forms in use at that period, and also to prove that ornamentation of such things at the present day is no new fashion.

CHAPTER III.

A. D. 100–200. CAUTERIZATION OF THE TEETH. PLUGGING TEETH WITH GUM AND IRON.—A. D. 540. FILING TEETH. —A. D. 1100. ABULCASIS.—A. D. 1541. EGENOLFF. PLUGGING TEETH WITH GOLD. FIRST MENTION OF CORRECTING IRREGULARITIES. — A. D. 1579. AMBROSE PARÉ. — A. D. 1728–1793. JOHN HUNTER.—A. D. 1790. — ARTIFICIAL TEETH IN THE DAYS OF WASHINGTON. REGULATING APPARATUS.—A. D. 1850. USE OF SCREWS. LATER IMPROVEMENTS.

ABOUT the end of the first century or early in the second, Marcellus, who lived some years after Celsus, recommended, instead of extracting teeth, to cauterize them with boiling oil or caustic substances, "stopping them, if carious, with gum or similar material," and "scooping out the decayed part with a common scalpel." In the same century, Cœlius Aurelianus mentions with hostile objections the practice of plugging teeth with iron plummets, which he calls "Ferrei Altheres."

A. D. 540. *Filing Teeth.*—Aëtius, who lived in the sixth century, advises that when teeth are carious they may be plugged with "galbanum or wax." He also speaks of filing the teeth, as if he were the first to perform this operation, but it appears that the Hindoos practised filing as a matter of fashion at a much earlier period.

A. D. 1100–1122.—The work of *Abulcasis* is evidently the earliest written account known of teaching that "teeth may be replaced by other human teeth or by artificial ones made of the bones of the ox," but the relics from the tombs of the Etruscans prove that this operation was practiced more than a thousand years earlier. See Figs. 6-8.

A. D. 1541. *Plugging Teeth with Gold.*—Egenolff published a little book in 1541 on "Medicine for the Teeth, to keep them good and sound." In this pamphlet are to be found some of the earliest suggestions on the art of preservation of the teeth by filling cavities with various materials, among which are mentioned gold leaves. As this old treatise contains some curious directions, I will quote verbatim the translation as published by Dr. J. W. White.[1]

"Corrosio is a disease of the teeth when they get holes and hollows, happening mostly to the molar teeth, especially if they do not get cleaned after eating; for the victuals adhere, decay, produce bad, acrid fluids, that eat and etch into the teeth, and keep on doing so, until the teeth are entirely destroyed, and one piece after another must, not without pain, drop off. This condition, according to Mesue, is stopped and cured in three different ways: First, by purging, as above mentioned. Secondly, by destroying the matter that hollows them out and eats them away; this is done by boiling cockle that grows in rye and wheat, with vinegar, and holding it in the mouth, or with vinegar in which capers-root with ginger is boiled. Thirdly, by getting rid of the hollow, which may be done in two ways. The first is to scratch and clean with a fine chisel, knife, file, or with any other instrument fit for it, the hollow and the parts attacked, and fill with gold-leaves, for the preservation of the remaining part of the tooth. The second is to use medicine, which is done by filling the teeth, after cleaning, with gall-nut and wild gallows-wood. Or, take henbane-seed mixed with gum storax, and make with it a smoke through a funnel into the hollow tooth. Or galbanum laid

[1] "Dental Cosmos," January, 1887.

on hollow teeth mitigates the pains. The pains are also quieted if the hollow teeth are filled with oppoponacum."

In speaking of extraction this writer says: "If the pains cannot be quieted in any way, in order not to produce damage to the other teeth or pains, you must take refuge in the last resort, *i.e.*, to draw out the bad teeth, which must be done by a person experienced in these things, as drawing out injudiciously is liable to do damage. Therefore, it should not be done when the pains are the greatest, but when they commence to get less; then shall the master free the bad teeth, with a fine instrument, from the gums, in order not to break away the gums with the teeth, and give rise to other ills besides the toothache. When now the gums are separated as much as possible from the tooth, it should be moved to and fro, so that it becomes quite loose, and then drawn carefully, not hastily, in order not to fracture, break or displace the jaw, which occasionally happens to those without experience, especially when it is an upper tooth. There is also great danger to the eyes if any tooth be drawn carelessly.

"But if the tooth is hollow, it should first be filled with lead, tin, silver, iron, or other proper substance, so that it shall not give way or break when it is taken hold of with the pincers. It shall also be drawn straight, and not bent from one side to the other, so that the root will not break and the jaw be not damaged. After the tooth has been extracted, feel carefully about if some little bone may not have been broken off, and, if you feel any, take it out with skill; if you cannot do that on account of the gums, cut them more away, and take out the splinters of the jaw by all means. The sign by which you may judge whether the jaw be fractured or something of it broken off, is when the cavity wherefrom the tooth has been drawn bleeds more than usual, and the jaw swells so much that one cannot open the mouth, and the cavity festers and swells. But if no damage anywhere appears, hold cold vinegar, in which there has been boiled gall-nut and pomegranate flowers, in the mouth. But if still some pains and aches remain, take in the mouth rose-oil, in which mastic has been boiled.

"Some who have a dread to have their teeth extracted, burn the bad tooth in this manner: They take a fine, suitable iron; make it hot; put it into an iron tube, which they do not warm, but let be cold; the hot iron protrudes a little below; and with this they burn the tooth. But if the tooth is hollow they put the glowing iron into the hollow of the tooth. This burning is very good, and not dangerous, for it silences the pains, and makes the tooth fall out by degrees in small pieces without pains. Some take, instead of iron, a nut-kernel or a little olibanum; make it hot, and put it in the hollow of the tooth. Or, take the fat of a green frog and smear it on the tooth; that will make the tooth to break in pieces and fall out without aches."

First Mention of Correcting Irregularities.—In this little book is found the earliest account, so far as I know, of a plan of treatment for the correction of irregular teeth, as follows: "It often happens that to children more than seven years of age, when the teeth begin to drop out, other teeth grow by the side of those which are about to fall out; therefore we should loosen the tooth about falling out from the gums, and move it often to and fro, until it can be taken out, and then push the new one every day toward the place where the first one was, until it sits there and fits in among the others; for if you neglect to attend to this, the old tooth will remain, become black, and the young one will be impeded from growing straight, and can no more be pushed to its right place."

A.D. 1579.—Ambrose Paré, in a treatise published in 1579, gave a fairly correct account of the teeth, their number, position, and uses. He was undoubtedly the first to describe the process of transplantation, though not from personal knowledge, but from report, and he mentions a case in which this operation was said to have been successful. He also gives minute directions for the extraction of teeth, and a chapter on "The Placing of Teeth artificially made instead of those that are lost or wanting." In this he says: "Teeth artificially made of bone or ivory may be

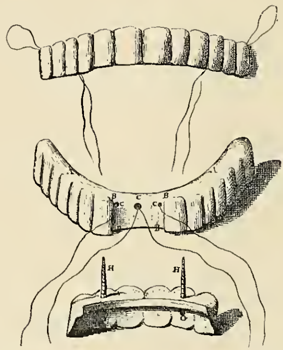


FIG. 21.—Ivory artificial dentures, A. D. 1746. (Fauchard.)

put in the place of those that are wanting; and they must be joined one fast unto another, and also so fastened unto the natural teeth adjoining that are whole; and this must chiefly be done with a thread of gold or silver, or, for want of either, with a common thread of silk or flax, as it is declared at large by Hippocrates." Thus it appears that no improvement upon the Etruscan and Phœnician plans were in his time known to this author. The process of transplanting mentioned by Paré was strenuously advocated, more than two centuries later, by the distinguished physiologist Hunter.

A. D. 1728–1793.—*John Hunter*, who wrote in the middle of the eighteenth century, dwells on the subject of the anatomy and treatment of the teeth. He gives an account of experiments in transplantation of teeth into other sockets, also into a cock's comb, and was one of the few writers of eminence who favored the operation in the mouth, but he says nothing of importance as to correcting irregular teeth. During the middle and latter half of the eighteenth century, some efforts in the line of correction of irregularities by artificial appliances were made by different dentists, notably by Fauchard (1746) and Bourdet (1786), but the devices were few and crude, consisting mainly of strings and flat metallic springs.

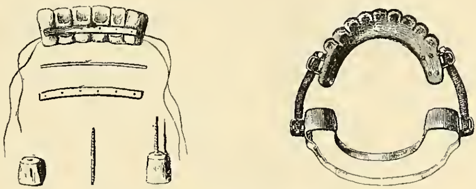


Fig. 22.—Ivory dentures, A. D. 1746 (Fauchard).

Fox, in 1814, and Catalan, in 1826, wrote extensively on dentistry, but little on regulating devices, and these were limited to the metallic spring; long-band tied to the teeth with strings; and the inclined plane. Harris (1839) describes some improvement in apparatus, but they are mainly based on the same principles. Further information regarding the application of these few devices to the teeth as used by these older writers will be found illustrated in a chapter on the Long-band in Part XV., Vol. 2.

A. D. 1790.—*Artificial Teeth.*—From the time of the Etruscans to the close of the eighteenth century, there seems to have been no great advance in the art of dentistry; especially, in the manufacture of teeth. By comparing Figs. 21 to 27, the status and progress of the art, during the last one hundred and fifty years, may be seen.

Figs. 21 and 22 illustrate different modifications of teeth described in Fauchard's work, published 1746. These con-

FIG. 23.—Bottom view of an Upper Set of Artificial Teeth (1793-1819).

sist of single pivot teeth, group pivot teeth (bridge-work) and full dentures. Some were tied in with strings, and others where held in place, by being mounted on gold spiral springs and frames of plate.

Four views of a double set of teeth, said to have been

FIG. 24.—Top view of a Lower Set of Artificial Teeth (1793-1819).

made by John Greenwood (one of George Washington's dentists), are shown in Figs. 23–26.

That Greenwood[1] was then regarded as among the first

[1] The first Directory of New York City, recently reprinted, contains (in the appended records of that period) two very curious and interesting newspaper notices, both of which are here transcribed. The first one is dated February 28, 1786, and the second, November 20, in the same year :

John Greenwood, dentist, No. 199 Water Street, substitutes artificial teeth in so neat a manner, as not to be perceived from the natural; *they give a youthful air to the countenance.*

J. Greenwood, dentist, *real maker of artificial teeth*, makes and sets in teeth, so exact as not to be distinguished from the natural, *they are not to be taken out at night*, as some falsely suppose. He likewise *transplants natural teeth*, and fixes them upon gold. He will wait upon ladies and gentlemen at their houses, and *may be spoke with* at No. 21 John St.

in his profession may be inferred from the financial ability of his patients, several of whom, it is claimed, paid as high as five hundred dollars for a set of teeth. This statement is supported by the following letter written by the General (then President) concerning some repairs which had been made after he had used artificial teeth for several years :

"MOUNT VERNON, June 6th, 1795.

"SIR:—Your letter of the 28th ult., with the parcel that accompanied it, came safe to hand. I feel obliged to you for your attention to my request, and for the directions you have given me. Enclosed you will find bank notes for fifteen dollars, which I shall be glad to hear have got safe to your hands. If you should return to Con——, I shall be glad to be advised of it, and to what place, as I shall always prefer your services to those of any other in the line of your present profession.

"I am, Sir, your very humble servant,

"G. WASHINGTON."

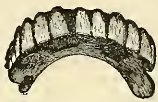


FIG. 25.—Front View of the Upper Set.

These dentures, which are now in the museum of the Baltimore College of Dentistry, are apparently made of hippopotamus ivory. The upper teeth are rudely carved out of two blocks joined between the central incisors, and are riveted to a gold plate covering the gums and roof of the mouth. The lower set is made entirely of ivory, in three

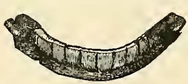


FIG. 26.—Front View of Lower Set.

blocks ; the teeth being carved from two blocks of a superior quality, and joined between the right central and right lateral incisors. These blocks are doweled to a lower block of inferior quality of ivory ; that block constituting the base-piece, cut away in the anterior portion, to let in the dental blocks, while the posterior extremities are left on the same plane of the antagonizing ends of the teeth, so as to serve as molars, but are not carved in the form of teeth. The posterior ends of the dental blocks are fastened to this molar extremity of the body block by wire, entering the grinding surface on the left, and the lingual sides on the right of the set, as in Fig. 24. These (like those made by Fauchard, 1746) were connected and held in place by long spiral springs, the ends of which were riveted to their posterior buccal sides. As will be seen in the illustration, decay had made ravages into the ivory which must have loosened the blocks. There are two gold patches, one for holding the posterior portion of the right upper block to the plate,

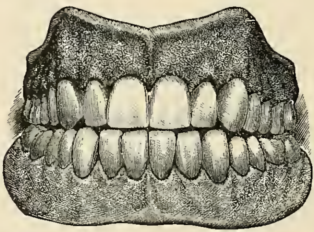


Fig. 27.—Modern Set of Artificial Teeth.

and the other for mending a fracture in the plate. The loosening of the blocks is still better proved by three other patches, which appear to be thin plates of steel, skillfully riveted to the blocks and the gold plate in the same manner as were the gold patches. This second attempt to repair the teeth was probably made by another dentist. These teeth and the patches are so clumsy that doubtless they caused much suffering.

Fig. 27, which is here given only for comparison, illustrates a set of teeth made nearly a century later (1886). Such teeth as well as the gums are now made entirely of porcelain baked upon platinum plates, swaged to fit the alveolar ridges, an improvement by Dr. John Allan.

A. D. 1850–88. *Regulating Apparatus.*—Extraction, finger pressure, and springs were the means of regulating teeth until about A. D. 1740. The last fifty or sixty years may be said to cover most of the ground of improvement in this art, and of these, the last fifteen have brought about far more progress than all previous centuries combined.

Until the discovery of the process of vulcanization of rubber, in 1839, most regulating apparatus consisted of the long-band, wooden wedges, strings, metallic plates, inclined planes and springs, but most of these were used in a somewhat crude form and in a rudimentary manner. After the Goodyear process of treating rubber became known, the easy adaptability of the rubber to the various needs in dentistry made it the principal material used for inclined planes and plates, aided by springs, wooden pegs, and elastic rings. Later, between 1849 and 1869, cleft plates came into use. These constituted, with minor exceptions, the instruments for regulating teeth until about 1872, after which the number of improvements rapidly increased.

Dr. Redman and, later, Dr. Richardson devised the hard-rubber plate surrounding the teeth and covering more or less of the alveolar ridge, in which plate wooden pegs were inserted to impinge against the teeth in such a manner as to cause them to move in the direction desired. Instead of wooden pegs, I have sometimes (since 1881) used screws, and found them efficient.

History of the Use of the Screw.—The priority in the use of the screw for regulating teeth, so far as I have been able to ascertain, lies between W. H. Dwinelle, M.D., of the United States, and Charles Gaine, M.R.C.S., of England.

In 1885, while delivering a lecture before the Dental Society of New York upon the uses of apparatus constructed upon the positive principles of mechanical action for regulating teeth, in which I referred to the question of priority in the use of the screw, a member in the audience volunteered the remark that he "saw jack-screws in Dr. Dwinelle's office as early as 1850," and said that "these were the first that were made for dental purposes in this country." According to the report of the proceedings of a subsequent meeting of this same Society, published in the "Dental Cosmos" for March, 1886, Dr. Dwinelle gave the following account of his inception of the use of the jack-screw. "Some time about the year 1845, I will not be positive as to the year, a circumstance occurred which developed to me the use of the steel jack-screw in the mouth in a way that I will now relate. At the time I speak of I had occasion to go with my preceptor into a hay-field to amputate a man's leg. An old set of English instruments was used, the amputating blade of which was a particularly large one. After the operation was performed the box containing the instruments could not be found. A search was instituted for it, but to no purpose. The next season, when it was found, the vicissitudes of climate, snow, rain, sunshine, and storm had made sad havoc with the box; the glue had melted, the coverings were separated, and it was a general wreck. All the instruments, save one, were found to be exceedingly corroded with rust and were utterly ruined; but, to my surprise and the surprise of every one, the amputating instrument blade, although it had separated from its wood and the hasp from the handle, was not rusted at all, and scarcely more than dimmed. On examining it closely I noticed that at the end of the hasp there was an irregular deposit, apparently of some foreign metal. By more careful examination and tests I ascertained that it was zinc. The whole mystery was then explained; the presence and contact of zinc with the steel had induced galvanic action which prevented its rusting, and the blade had thereby been preserved. Somebody before me had discovered that principle, so I lay no claim to its discovery.[1] The effect of zinc upon this blade instantly suggested to me that steel instruments of any form or character could be used in the mouth with impunity by simply associating zinc with them or attaching it to them. Now, what is the most valuable and powerful instrument known to mechanics? Why, the jack-screw. And the steel jack-screw suggested itself to me. Within a few hours I had made several of them of different sizes, from one-quarter of an inch to two inches long. Some of them I have with me now. I made these jack-screws of different forms, adapted to different cases; in one side or end was drilled a small hole, which I loaded with zinc. So long as the zinc remains there (it will waste away in time and need refilling), the instrument will not rust."

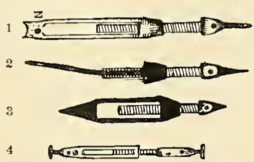


FIG. 28.—Steel Screw-Jacks (Dwinelle).

I have quoted as much from Dr. Dwinelle's statement as I think pertinent to my present purpose, or necessary to do justice to him. In that statement Dr. Dwinelle dates his discovery as far back as the year 1845. On page 2 of Johnston's Miscellany for January, 1877,

[1] Sir Humphrey Davy.

there is an article giving the date of this occurrence as "In the summer of 1849." As Dr. Dwinelle personally gave me this Journal to read the quotation from him, as telling the facts concerning the matter for publication in this work, the date above reported (1845) must be erroneous.

Fig. 28, drawn from the originals, illustrates two kinds of screw-jacks: 1, 2, 3 show three modifications of pushing jacks, and 4 one of a draw-jack. The latter is anchored in notches in ferules placed around the teeth.

Regarding the claims of Dr. Gaine, I received from him in 1878 a letter, also a pamphlet of some thirty-five pages, which he claims to have written and published in 1856. In it he mentions having performed operations with the screws, in connection with gold or silver plates which were swaged to fit the teeth. These plates were of various sizes, and not only saddled over one or more teeth, somewhat as does what is now called an interdental splint, but some of them extended a short distance over and rested upon the gum on either side of the line of teeth, as shown in Fig. 32. The screws were placed in holes bored in appropriate places through these plates.

Some of the devices used were on exhibition at the World's Fair of 1851 in London, England. I quote from this pamphlet Dr. Gaine's account of the first case in which he used the screw. It was "that of a young lady, aged eighteen. The upper jaw presented the following appearance: the two central incisors and canines projected, and the laterals were forced so far within the dental arch, that the lower teeth closed on and over their anterior surface. The two first bicuspids had been extracted some time prior to my seeing her.

"My first object was to separate the jaws sufficiently to keep the under teeth from closing on the lateral: accordingly, a gold plate was adopted to *cap* the molar teeth, and secured by means of bands attached to the second bicuspids; a thick piece of gold was then brought round the front of the mouth, and the plate doubled posteriorly over the laterals, anteriorly over the canines and central incisors, in order to make it sufficiently strong to carry and bear the action of *screws*.

"In less than a fortnight from the time the plate was first adjusted, the misplaced laterals were brought to shut *over* the under teeth, while the projecting centrals and canines were so much improved as to require the insertion of longer screws. In the course of three weeks the teeth presented a regular appearance. Another model of the mouth was then taken, and a new plate made to *cap* all the teeth in the upper jaw, so as to keep them in their places until they became quite firm in their sockets: this plate was worn about six weeks."

In a footnote Dr. Gaine says this case occurred during the time that he was assistant to Mr. Wood, of Brighton; and that it is given with some minuteness, from its having been the first case in which he used the screw. "I may be permitted to add," says Dr. Gaine, "that Mr. Wood considered the process and results sufficiently novel and important to be illustrated by models and plates, which were accepted for, and their merits acknowledged at, the Exhibition of 1851. Mine was the invention, his the κῦδος."

Desiring to settle the question of priority in the use of the screw for regulating teeth, I made special efforts to obtain information, but with little success until 1887, when I met each of these gentlemen at the International Medical Congress in Washington. They kindly consented to send me the data concerning the matter, and if possible the devices first used, which I wished to procure in order that credit might be given where it was due. On Dr. Gaine's return to England, Dr. Wood sent me the apparatus and the casts for one case, exhibited in 1851, but not the device used in the case here described. Figs. 29 and 30 illustrate the appearance of the case before and after the operation, and Fig. 31 the device as it appeared upon the cast ready for action. The first step in the operation was the extraction of the right first bicuspid and the left first molar as in-

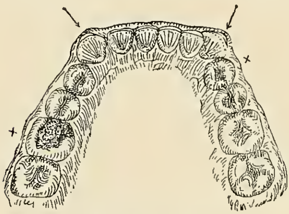


Fig. 29.—Appearance of Dr. Gaine's case before the Operation.

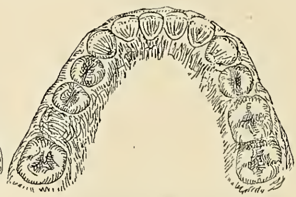


Fig. 30.—Appearance after the Operation.

dicated in this figure. The plate was then swaged to cover the entire lower dental arch, after which portions of it were cut away over the cuspid and bicuspid regions and three gold screws set into the plate as shown. The operation consisted in forcing the outstanding cuspids and instanding left first bicuspid into line. This was accomplished by ad-

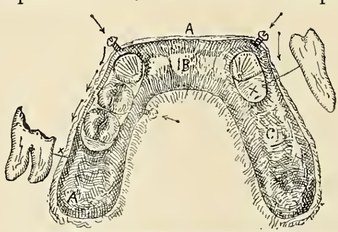


Fig. 31.—Appearance of the Device when first applied to the Teeth.

vancing the screws in the direction indicated by the arrows.

Fig. 32 illustrates the left half of the plate cut at the symphysis A to show its shape. It also shows the position of two of the screws. Fig. 33 illustrates section views of the plate cut transversely across the region of the molars and at the point A (see Fig. 31). This plate not only covered the crowns but extended a short distance over the gums.

Fig. 34 is a photo-electrotype illustration taken from a sketch drawn by Dr. Gaine, showing the form of another device used by him about this time.

From all that can be gathered it is plainly seen that

Fig. 32.—Left half of Gaine's Device.

Fig. 33. -Section views of Gaine's Device.

both these gentlemen hit upon the idea of using screws at about the same time, but the individual claims of priority are not very clearly proved. While the evidences indicate that Dr. Dwinelle was not the first to use the gold screw, it is equally certain that Dr. Gaine was not the first to use the steel screw; therefore, so long as this point rests thus, it seems fair to award to each gentleman the credit of being

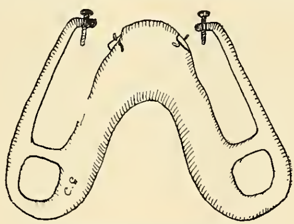


Fig. 34.—Regulating Device by Dr. Gaine.

the first to use the screw for regulating teeth — to Dr. Gaine for being the first to use the screw simple, and to Dr. Dwinelle the invention of the screw-jack.

In 1859 Dr. A. Westcott described in the "Dental Cosmos" a device consisting of several screw-jacks arranged radially for enlarging the dental arch. See Fig. 35. In the Medical Press, Dr. E. H. Angell published in 1860 an account of a modification of the Dwinelle screw-jack, having two crutch-like extremities made for the purpose of widening the dental arch.

As Fig. 36 so clearly shows the construction of this device, it is not necessary to describe it further than to say

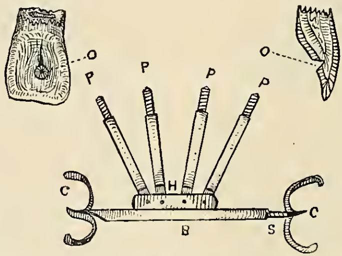


Fig. 35.—Dr. Westcott's Device for Enlarging the Arch. *C*, clasps; *B*, anchor jack; *P*, radial jack; *O*, *O*, pits in teeth for screws.

it was made upon the unnecessary and objectionable plan of a double-ended screw reversely threaded.

From this time until 1871, no remarkable improvement in regulating devices, especially in those founded on the use of the screw, was published. But since the latter date great advance has been made in all kinds of regulating devices. The improvements in the line of springs have been made by

Fig. 36.

several different members of the profession, among whom may be mentioned Drs. Talbot and Coffin.

There is a very great difference between the manner in which the screw was first used and the part that it now takes in the construction of devices. It was first used only as a cause of force to move teeth ; now, besides this, it is made a means of holding the different parts of regulating apparatus together, and of anchoring it to the teeth ; thus the screw has been rendered more effectual and capable of meeting the requirements of a great variety of cases. It should also be noted that while steel was once advocated as the only practicable material to use for jack-screws, owing to the hardening process of gold, now understood, it is not universally used at the present day. In my practice steel has long ago been abandoned in favor of gold, or gold and iridium, which I think have superior advantages over steel, such as ease of manufacture, repair, and alteration; facility of connection of parts with other things by means of hooks and rings of gold ; and last, though not least, from the fact that gold is delicate yet strong ; that it is more pleasing in appearance than steel; and is not only preferred by patients, but the operation is generally more highly appreciated by them. During the last fifteen years, 1872 — 1888, the number of inventions and improvements in which the screw constitutes a portion of regulating apparatus is many times greater than were made in all the past. Most of these devices and the *original* inventors and the dates of their inventions, so far as ascertained, will be mentioned in their appropriate places in this work.

PART III.

On the Etiology of Irregularities of the Teeth.

CHAPTER IV.

NATURAL LAW.—TEETH OF MAN.—DECIDUOUS AND SECOND SETS. — OVARIAN CYST CONTAINING TEETH. — A RARE CASE OF ABNORMAL DEVELOPMENT. — TRANSPOSITION OF ANATOMICAL PARTS.

IT is often remarked that "Nature never makes a mistake," yet very few believe the saying. If it were true, and defects were only apparent, not real, then there would be no need of a work like this. But without attempting to prove the falsity of the proverb by discussing the subject in detail, let us assume abnormality to be a fact of frequent occurrence, and consider the question from this point of view.

While antagonistic forces are frequently sufficient to cause abnormality, it must be admitted that there are certain laws underlying variations of structure, which are ever struggling against the changes wrought by environment, and which tend to reduce confusion to order and deformity to symmetry. If the operation of these laws is hindered by opposing forces, the delay is only in proportion to the opposition. In time success is attained, if not by elimination of the defect, certainly by extinction of the race, thus leaving the fittest to carry on, through evolution, the work of progress. Not only is this true on general principles, but it will apply to special evils. Remove the cause of disturbance in season, and much may be expected of nature, both in the line of cure of diseased tissue, and in the eradication of deformity, especially so if the defect is not congenital. A cleft palate or a club foot may not come within the possibility of natural correction in the present generation, but Nature will generally show her power by the absence of the defect some generations later. In instances where a defect makes its appearance immediately or soon after birth, this power often asserts itself successfully in the first generation after, and sometimes in the present. A crooked plant grows upright when the stone which pressed it down is removed. A puny child becomes robust upon suitable food, direct sunlight and fresh air; and a tooth moves into its proper place if the obstructions are cleared away in season. Upon this phase of natural law the occupation of the medical profession greatly depends ; the physician relies on it to assist in curing disease, the surgeon to aid in correcting deformity.

If the cause of deformity is allowed to remain too long, nature alone has not sufficient power to correct it, and we must have recourse to art.

Teeth of Man. Deciduous Set.—Adult human beings have in the course of their lives two sets of teeth, one for childhood, which exists a short but sufficient time; one for adult life, which exists a much longer but often insufficient time. The first set is denominated deciduous, sometimes "temporary ; those of the adult are known as "permanent ;" but strictly speaking, these terms are inaccurate ; time can be regarded merely as relative—either set may be temporary or permanent, depending upon the length of life. The first set is relatively as permanent for the child as the second is for the adult; more so, considering the duration of their co-existence. As every one knows, health depends largely upon proper mastication of food. A slight indigestion will cause the death of a child, while an adult may suffer from dyspepsia for years without any fatal consequence. Either set is absolutely necessary for the health, comfort and beauty of the individual. Each should be retained until its presence is more objectionable than its absence.

The treatment of the subject of evolution of teeth of the animal kingdom naturally comes in at this place, but as the field is so broad, I shall not attempt it, but will refer my readers to the writings of Wortman, Dall, and Sudduth.[1] It may be said, as in the words of Prof. Peirce, "by tracing the development of the deciduous teeth from the appearance of the epithelial eminence, inflection, and the enamel organs, in fœtal life, we recognize various progressive changes in the germinal tissue between the seventh and the seventeenth week. The modifications which are taking place during this period are in the embryonic structures for the development of the twenty deciduous teeth, and from the fifteenth week for the development of what is recognized as the first molar of the second set. From the seventeenth week these rudimentary structures for the deciduous teeth begin to assume on their prospective coronal extremities the shapes of the future crown; and as this process is completed by the development of ameloblasts for the enamel and osteoblasts or dentoblasts for the dentine, the solidifying process commences by the deposition of the salts of lime in these previously prepared tissues. This process goes on, probably not without temporary interruption, until the crowns are completed, the incisors at about the fortieth week of fœtal life or at birth, the molars and cuspids when the infant is not more than six months of age. It is now that the crowns are advancing toward the mucous surface, facilitated by a three fold action, viz., the elongation of the dental pulp. the calcification of its surface to form the dentine of the root, and the adhesion of the dental sac or follicle to its solidified periphery: this last process places the cemental germ or matrix in position, and

[1] "American System of Dentistry," Vol. I. pp. 337–658. (Litch.)

stimulates it into functional activity, for until this period we have only had preparation for the development of two of the hard dental tissues, but with this the germinal development is completed, and growth henceforward progresses."[1]

FIG. 37.—Lower Jaw at the seventh Month of Fœtal Life.

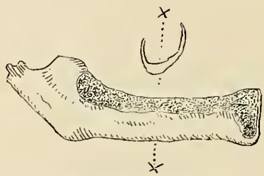


FIG. 38.—Left half of the same.

Fig. 37[2] illustrates the top view of the lower jawbone at the seventh month of fœtal life, the rudimentary teeth having been removed. Fig. 38[2] illustrates the lingual side of the

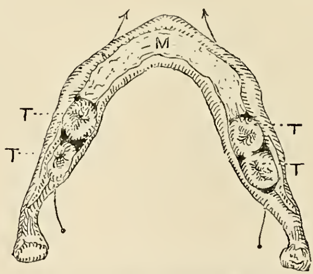


FIG. 39.—Lower Jaw at eighth Month (fœtal).

left half of the same, also a vertical section, cut at the line XX.

Figs. 39[2] and 40[2] illustrate the same views of the lower jaw of an eight months' fœtus. M illustrates the membrane

[1] "American System of Dentistry." Vol. III., p. 630.
[2] Drawn from specimens in the author's cabinet.

through which the teeth force their passage, the posterior portion of which is cut away to show the teeth, T, T, beneath. Arrows indicate the position of the dental canals.

In some cases, the teeth break through the enclosing tissues in regular time and order; in others, in an irregular and disorderly manner. Irregularity of deciduous teeth, however, is of rare occurrence, and, whenever present, is generally confined to one or two, more frequently the incisors. So rare are these cases, that a dentist with an extensive practice may not see an instance more than once or twice a year.

The cause of irregularities may be prenatal or it may be extraneous, as in wrong antagonism or some habit,

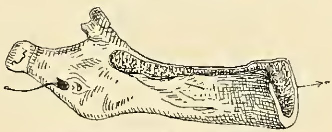


FIG. 40.—Left half of the same.

as of biting, or sucking artificial nipples. So slight, as a rule, however, is the influence of habit, that, for the purpose of correction, frequently no interference further than discontinuance of the habit is necessary. A defect arising from wrong antagonism or the crowding of deciduous teeth seldom requires more than a little grinding away of the interfering portion of the tooth which has caused the defect. Irregular deciduous teeth in themselves typify nothing regarding the second teeth, nor can they in any way be regarded as indicating the degree of mental or physical development of the individual.

The Second Set.—Concerning the second teeth the matter is quite different; to treat of them and to tell what may be done for their improvement is the principal object of these volumes. Many hypotheses have been advanced upon the cause of their irregularity; some apparently contain the elements of truth, while others are valueless. Instead of setting up erroneous criticisms, so habitual with some writers, as so many "straw soldiers to brush away," we shall, here, deal only with what seem to be the more reasonable aspects of the question. Whether man's original dentition included four molars on each side, as suggested by the author of the "Descent of Man," or six incisors in each arch, two of which are now missing and two more teeth following the path that leads to extinction, as hinted by Windle and by Webb[1] and Thompson[2] in regard to the third molar, there is some reason for further inquiry in this direction; but we will leave these points for the discussions and discoveries of evolutionists.

Of irregularities of the teeth, it may be said that there are four principal classes: first, when the malposed teeth stand outside the line of the dental arch proper; second, when they stand inside the line; third, when they stand on the line, but in wrong positions; fourth, when the dental arch is too large, too small, too wide, or too narrow.

When teeth are irregular they are not only unsightly, but as the irregularity implies overcrowding, it is one of the principal causes of their decay, if not indirectly one cause of disease of the sockets; in fact so powerful is its influence that it will in time destroy the strongest and most healthy teeth. Besides these dangers arising from irregularities there are other evils, such as imperfect speech, impaired digestion, and a distorted facial expression. The methods of treatment for bringing about the best results will be described under appropriate heads.

The consideration of the malformation of the individual

---

[1] "Teeth in Man and Anthropoid Apes," "Anthropological Review," July, 1867. [2] "Dental Cosmos," March, April, May, 1878.

tooth now naturally follows; but as this question is so extensively treated in several works, such as those of Magitot and Litch, it seems unnecessary to dwell upon it here.

The proper arrangement of the teeth is that which best combines use with beauty. The principal requisite for their usefulness is proper antagonism; that for beauty, is the curvature of the dental arch most becoming to the face, together with such an arrangement of the teeth upon that curve as will bring about the most pleasing esthetic effect. Upon the forms of the arches depend the general contour of the individual face,—to describe them conveniently, I have reduced them to three classes—the Gallic,

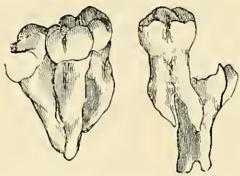


Fig. 41.—Teeth joined together (Flagg).

Latin, and the Celtic.[1] (See Chapter on Dental Arches, Part XXI.)

While a large proportion of the second teeth are, esthetically speaking, formed symmetrically, there are many instances in which the irregularity is so marked as to constitute deformity. These are found in a great variety of forms and positions, distorted and united, as illustrated in Fig. 41;[3] erect, inclined, horizontal, and even wrong end up.

After birth, some appear through the gum, others remain buried within the alveolus; others even appear externally, as illustrated in the case described by M. Magitot (Fig. 42),[2] or in the nares, an interesting illustration of which is shown

[1] First published by the author in the "Dental Cosmos," March, 1878.

[2] "Musée de la Sociéte Odontologique de Londres," M. Cartwright.

[3] From "Dental Cosmos."

in Fig. 43, copied from the same work. This illustrates a top view of a case from M. Forget, a cuspid with its crown T, lying in the posterior portion of the palatine bone. Magi-

FIG. 42.—Eruption of a Tooth through side of the Face (Magitot).

tot illustrates from the same museum a case where a molar broke through near the central portion of the roof of the mouth. This is shown in Fig. 44. Fig. 45 illustrates from

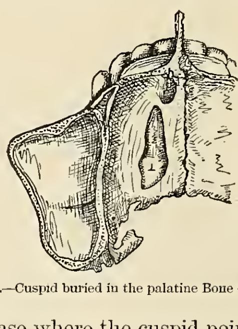


FIG. 43.—Cuspid buried in the palatine Bone (Forget).

Forget another case where the cuspid points in the opposite direction, and lies in the lingual wall of the alveolar process. This figure is said to illustrate the tooth as liberating itself through the process by formation of an abscess. Dr. Sayre, in the "American Medical Monthly,"[1] describes the case of a girl who had three molars ejected, one after the other, through the meatus auditorius. These cases serve to show that they are either products of dentigerous cysts or that the germs of the teeth must from some cause have been displaced from their proper position long before the teeth appeared, probably even before birth. Dr. Ward Cousins presented for examination to an English Medical Society a perfect incisor removed from the orbit of a child two years of age. This was not regarded as a product of dentigerous cyst, but as a tooth displaced in early development."

FIG. 44.—Molar in the Roof of Mouth.

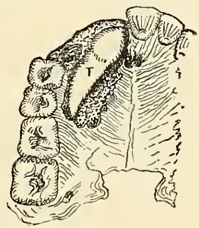


FIG. 45.—Cuspid lying horizontal in the Alveolar Process (Forget).

A very remarkable case of abnormal development was described at a meeting of the Southern Dental Association (U. S. A.) by Drs. Catching and Moore. The description was substantially as follows:[2]—"A girl, fifteen years of age, was born in the sixth month of gestation. She was always very small and delicate. At six months of age a set of small teeth developed, which disappeared within three months. At eleven months she began teething again, and at fifteen months an entire set had developed, which in six weeks became dark in color and crumbled away like chalk. Her weight at that time was ten pounds. She was well cared for, fed on breast-milk, and given cod-liver oil and

[1] 1860. [2] Published in "Dental Cosmos," Nov. 1886.

lime-water three times daily. At two and a half years of age a third set of teeth, small and fragile, appeared, which she retained until her fourth year, when they were removed, with the result of decided improvement in the child's health. Some of these teeth had very small roots, others none. The girl remained without teeth for several years, with the exception of four curious little upper incisors, shell-like and rootless, so slightly imbedded in the gum that they were easily removed with the finger-nail. At seven years of age she weighed only thirty pounds. The fourth set of teeth began to appear in her eleventh year, the complete set being formed within about four years."

Teeth found in an Ovarian Cyst.—Although not quite relevant to the subject of Causes of Irregular Teeth, yet as a phase of abnormality, the mention of a case of ovarian cyst in which several teeth were found may be interesting. This remarkable cyst and its contents were described in the "Independent Practitioner" in 1887 by the editor, Dr. W. C. Barrett, substantially as follows:

"The specimen, which appears in the illustration (Fig. 46) a little less than its actual size, consisted of a considerable amount of hair (some of which is nearly a foot long), a bone which appeared to be a partially developed superior maxillary, and twelve teeth. The posterior portion of the mass from which the hair extended bore some resemblance to an occipital bone.

"Of the teeth, which appeared to belong to different periods, there were three very well-developed molars, four bicuspids, and some incisors. Some of these apparently belonged to the first dentition, and some to the second, but all were jumbled together. Some of the incisors had serrated edges, such as are often found in those of the second set. The roots of some of the teeth were fairly well developed, while others were rudimentary, but the cusps of the

FIG. 46.—Teeth and Hair taken from an Ovarian Cyst. (Barrett).

crowns were perfect and of normal size. The hair was auburn in color, and appeared like that usually found on the head of an adult. It did not resemble the hair of an infant. In fact the hair and some of the teeth appeared like those of a person at least twelve years of age.

"The woman, of twenty-seven years of age, from whom this specimen was removed, had miscarried in her first pregnancy, about the fifth month. In less than a year the usual symptoms led her to suppose that she had conceived again. But at the end of four months these symptoms ceased. The patient remained in her usual health for three years and a half, when abdominal enlargement again appeared, accompanied by considerable pain in the ovarian region, and she became much emaciated. An ovarian cyst was diagnosed, and an operation performed for its removal. The diagnosis proved correct; the cyst was removed, and upon examination was found to contain, besides the hair and teeth mentioned, a milky substance instead of the usual albuminous fluid.

"What was the origin of this growth? Was it a case of ovarian fœtation, or had it another cause? If it were the former, how could the teeth have been developed, even though progression had been active during the four years between the supposed term of conception and that of the operation? Is it possible for hair to grow to that length and permanent teeth to develop in that period of time? All the tissues in the specimen appeared to be of greater age than the duration of the supposed pregnancy would permit. Nor, so far as the history of the case could be ascertained, was there any proof of pregnancy at all, except the presence for a short time of sensations and appearances corresponding to the usual symptoms.

"It would seem that this might possibly be an undeveloped ovum of the same age as the woman herself. Perhaps at the time when the mother of the patient conceived, another Graafian vesicle matured and was fertilized; and in the course of that mysterious process of development of the fecundated ovum, the one was partially blighted and became enveloped in the tissues of that which matured. It became encysted, but placed in the position in which it was found, the dermoid tissues went on developing to a certain extent, and resulted in the teeth and hair found in the specimen. At the period when the history of this case commences, the cyst began to enlarge, and degeneration ensued. This precipitated an operation, by means of which the tissues of the ovum, that had existed in this condition for something more than twenty-seven years,—the age of the patient,—were found."

Concerning this interesting case, Roswell Park, A. M., M. D., Professor of Surgery in the medical department of the University of Buffalo, gives the following as his opinion: "The above-described tumor plainly belongs to the class of dermoid cysts, which are notoriously frequent about the ovary and testicle, though they may be found in almost any location, one having been demonstrated in the brain. It is one of the peculiarities of these growths that they most often contain fat, hair, teeth and skin, all of which are products of the external blastodermic layer of the embryo, and even bone, which comes from the middle layer. For many years these tumors were held to be products of a conception which had failed to reach the Fallopian tubes, but in view of later researches this view is no longer tenable. Such cysts are always congenital in origin, though they may be late in development. In the case in question, the growth of the tumor was probably excited by the physiological activity accompanying the first pregnancy; it advanced slowly, provoked such symptoms as to lead to a suspicion of a second pregnancy, halted in its course for a

6

number of months, as any tumor may, and then resumed active growth. The milky fluid which it contained would doubtless have been found, upon analysis, to contain cholesterine in abundance.

"With regard to their more exact method of origin, we must agree with Heschel and His that they arise from isolated portions of the epiblast or mesoblast (external and middle blastodermic layers) or both, which during the development of the embryo have been displaced and located in some place where they do not properly belong. Such islands of tissue retain nearly all their embryonal possibilities, and, given an impetus, such as pregnancy in the above case, may in the early or adult life of the individual begin to develop into any or all of the tissues which they might normally produce. It was especially His who showed that in the part of the embryo from which the internal genital organs are developed, the three germinal layers are exceedingly complicated and combined, and the comparative frequency of dermoid tumors in this location is thus made clearer. This corresponds also with the inclusion theory of Cohnheim. A dermoid cyst is always a monocyst, though it may occur with others.

"The peculiar interest in this case, to most dentists, will lie in the peculiar arrangement of the teeth, those resembling deciduous and permanent being promiscuously mixed. We may hold, I think, that a dental germ under abnormal conditions may develop, according to its surroundings, in various abnormal ways. Assuming that a permanent tooth must have, say fifteen years for proper growth, we have here a patient of twenty-seven, with a tumor which must have had its beginnings in her own fœtal life. Assuming, further, that it made no progress till she had attained the age of puberty, which is by no means assuming too much, but is most probable, we yet have sufficient time for the full growth of a permanent tooth—and this, too, on the assumption that because such a tooth usually requires so much time it inevitably does, which is by no means proven. Probably the deciduous teeth noticed in the specimen were of later growth; nevertheless we must not expect obedience to the ordinary laws in such apparently lawless growths, where all development notoriously goes on with seeming inconsistency. While in reality we yet know very little about dermoid cysts, we are sufficiently familiar with them to assign the above case and specimen its probable place."

Transposition of Anatomical Parts.—Besides displacement of teeth, it sometimes happens that members of the body, instead of being in their proper places, are found present in some other part, perhaps in the opposite side or even in the opposite extremity. Among the first to notice this peculiar phenomenon, which no one has yet been able to explain, was Meckel, who mentioned that when a muscle of the arm varies from its proper type it is almost always found to resemble the corresponding one in the leg, and that the one in the leg resembles the normal form belonging to the arm. This peculiar transposition of form is not confined to one or two muscles or members. I once saw a woman of remarkable beauty in other respects whose thumbs resembled great toes, and the great toes as fully resembled thumbs. This peculiarity was also observable in her father.

Although the line from effect to cause has not been satisfactorily traced, yet so great an authority as Isidore Geoffroy thinks that some varieties of monstrosity are thus correlated.[1] From all that can at present be gathered, I am inclined to believe that, if sufficient careful thought should be directed along this line of investigation, important dis-

[1] See an excellent paper by Fisher, in "Transactions N. Y. Med. Soc. 1865-66."

coveries will be made that will throw light on the question of radical transposition of teeth.

A distinction should be made between the cause that locates a side tooth in the front portion of the jaw and that of the chance gliding-off of a tooth—as, for instance, a cuspid, guided to the posterior side of the first bicuspid, because of an inclined surface of the apex of its root.

CHAPTER V.

"SHRINKAGE" OF THE JAW.—ARREST OF GROWTH OF THE JAW.—OUGHT THE ALVEOLUS AND THE JAWBONE BE REGARDED AS ONE?—ARE TEETH NECESSARY TO THE GROWTH OF THE JAW?

THE normal shape of the dental arch, as before mentioned, differs in different people, and in some respects is typical of race. That which would be esthetically most suitable for the large round English or German head might be a disfigurement in the mouth of the typical Spaniard, with long features and thin face. The line of the normal arch is a curve resembling the Roman letter U, differing from it in a greater distance between the ends of the arms. Deformities of the arch may be considered under two general aspects; that which is a violation of esthetic harmony or beauty, and that which interferes with usefulness. In the first, the condition which constitutes deformity exists when the arch detracts from the beauty of the face; the second or utilitarian aspect is defective when the sizes of the arches are unequal, causing imperfect antagonism. These deformities of the arch may or may not be the result of an irregular arrangement of teeth.

Irregularity of the teeth may be attributed to one or both of two causes—an inherent defective development of the jaw or of the teeth, or some extraneous circumstance which has acted on the parts involved. That is to say, the cause of the derangement may be in the malposition of the germs of the teeth, or it may lie in the environments, arrested or defective development of the maxillary bones and alveolus, as in cases of cleft palate, or the inadequacy in size of the jaw and alveolar ridge. The extraneous causes, on the other hand, act from without—as, for instance, in the case of improper antagonism. In the past, the so-called "shrinkage" of the jaw, which has been asserted to be one of the chief causes of lack of room for the normal arrangement of the teeth, was supposed to result from premature extraction. This view now receives but little support. Premature extraction may tend to retard, and possibly to arrest, the growth of that section of alveolus, or it may be the cause of the

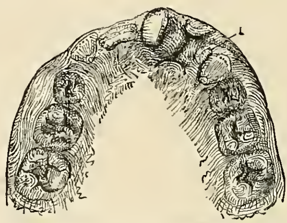


FIG. 47.—Derangement of the Teeth caused by Cleft Palate.

straggling of succeeding teeth, so as to stand upon the territory belonging to their successors; but its influence, if it have any, upon the jawbone itself is believed to be very trifling. We must therefore look to other causes for insufficient size of jaw.

Arrest of Growth of the Jaw.—Probably one cause of irregularity lies in the dwarfed or arrested growth of some portion of the jaw. In considering this aspect of the question, the difference between arrested growth and arrested development should not be lost sight of. This may be best exemplified by the arrest of brain development in childhood, manifesting itself by absence of intellectual strength, while the physical growth of the head and brain proceeds to the normal size and in some cases even beyond it. In other cases, not only the development of the brain or that feature of it that controls thought is arrested, but the growth of the brain itself, as exemplified in the microcephalous idiot, with a small head sloping forward to the eyes, and prominent ape-like jaws on a strong body.[1]

Some varieties of monstrosities are the consequence of an arrest of development or growth, one or both. A cleft palate, which disturbs or prevents the development or the normal placing of one or more incisors, generally results from arrest of sutural development before birth, and the arrest of

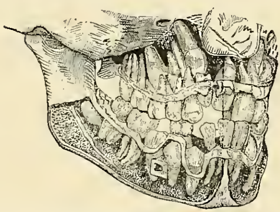


FIG. 48.—Illustrating irregular unerupted Teeth (Tomes).

growth of the jawbone, including the alveolar ridge, is generally post-natal. When the latter is the case, as mentioned elsewhere, it appears to be a cause of irregular arrangement of an overcrowded nature. In other words, there is not sufficient territory for the inhabitants to stand in the normal line; therefore the line of teeth is either zigzag, or in some portion doubled.

Fig. 48 illustrates the appearance of a dissected case, showing the malposition of unerupted teeth in a child about fourteen years of age. (From Tomes's work.)

Sometimes a seeming arrest of the growth of the jawbone occurs in the children of parents whose jaws are large and ample for the teeth; but according to my observation

[1] Vogt's "Memoire sur les microcéphales," 1867.

this unbalanced condition of the jaws is more generally found in the children of parents in whom there is a radical difference in the sizes of the jaws. This difference is not always carried out through the entire system, for it is often found where both parents are otherwise seemingly almost of the same size. Whether this latter condition is to be accounted for by arrest of growth, or by what evolutionists call "Reversion," namely, the appearance of some peculiarity of a remote ancestor or member of the line, of course is not always easy or even possible to discover. That the doctrine of reversion has some basis can hardly be denied in the face of the many evidences in its favor that can be given,[1] and if this be granted it is apparent that the inheritance of form and size of jaws of early progenitors is quite as possible as the inheritance of one gray eye and one blue eye, or of black hair and light blue eyes, which everybody knows sometimes appear in the same individual, after having been almost forgotten in family tradition.

As the bones of the upper jaw are associated and developed with the bones of the cranium, it has been suggested by one writer that arrested development and growth of the former may be due to premature calcification of the sutures. Has it been proved that bones never grow after they are united in suture ?[2]

Although it would probably be very interesting to some of my readers if an attempt were made to trace this question of development and growth back from effect to cause in all its various correlations, but such a discussion would be of doubtful relevancy in a work like this. That the time will come when the causes governing abnormalities in the arrangement of the teeth. as well as the causes control-

[1] Dr. A. Ferre. In the "Cyclopedia of Anatomy and Physiology," 1859, Vol. V., p. 642. [2] There is some force, however, in this theory.

ling many other like phenomena now unknown or imperfectly known, will be better understood, there is no doubt; but probably when that day arrives other problems now unthought of may present themselves, the solution of which is necessary to a full understanding of the subject.

In studying this question, as before hinted, I think that if the plough of investigation should be run along the line of evolution it will turn up some important truths that will bear upon the subject, but I do not imply that belief in evolutionary investigation necessitates a belief in catarrhine origin[1]; nor that the irregularities must be traced back farther than a few generations; nor that anomalous conditions caused by the crossing of different types is the same thing as reversion.[1] In considering these phases of the question, it is also important, as I shall hereafter point out, that we should consider the process of gradation that always takes place in succeeding generations, a process which in time usually leads to harmony in the proportion of parts.

Ought the Alveolus and the Jawbone to be regarded as one?—The alveolar process is a bony U-shaped ridge that holds the teeth in place. In other words it is composed of bony tissue that has for one object the affording of mechanical support to the teeth. This ridge in its entirety begins posteriorly near the base of the tongue on one side, and extends along its border to the corresponding point on the other. Charles S. Tomes, in his "Dental Anatomy," describes its development as follows:—"The alveoli were first built up as crypts with overhanging edges, enclosing the temporary teeth; then they were swept away in great part to allow of the eruption of the temporary teeth; and next they were rebuilt about the necks to form the sockets of the deciduous teeth. Once more, at the fall of the deciduous teeth, the alveoli are swept away, the crypts of the permanent teeth are widely open, and the permanent teeth

[1] The author is, however, a believer in man's evolution from a low type

come down through the gaping orifices. When they have done so, the bone is re-formed so as to closely embrace their necks, and this at a period when but little of the root has been completed." Mr. Tomes thinks it is impossible to insist too strongly, that the sockets grow up with and are moulded around the teeth as the latter elongate, and he says: "Teeth do not come down and take possession of sockets more or less ready-made and pre-existent; but the socket is subservient to the position of the tooth; wherever the tooth may chance to get to, there its socket will be built up around it." (See Fig. 48.)

"During the period of eruption of the permanent teeth the level of the alveolar margin is seen to be extremely irregular, the edges of the socket corresponding to the necks of the teeth, whether they have attained to their ultimate level or have been but just cut. And when temporary teeth have been retained for a longer period than is normal, they sometimes become elevated to the general level of the permanent teeth (which is considerably higher than that of the temporary teeth), so that they take their share of work in mastication. When this is the case the alveoli are developed round them, and come to occupy with the tooth a higher level than before." If this elevation of the alveolar border takes place, as Mr. Tomes states, and every dentist of experience knows it does, then there must be some other influence for the growth of this portion of the alveolus that so nearly buries the crowns of these first teeth than that derived from the deciduous teeth involved. Even admitting that the influence is from the portion of the alveolus that surrounds the adult teeth at a distance, the fact that this growth takes place at a distance from them is proof that the growth of the alveolus does not always require contact of the succeeding teeth.

Changes consequent upon the growth of the person continue to take place in the size and form of the alveolus after the eruption of the teeth. Some idea of these changes and of the movements of the anterior teeth. which also change position, may be derived from the following figures, which are taken from Dr. G.V. Black's work on "Periosteum and Peridental Membrane." These figures are section views of upper central incisors and their alveolus; A, showing the maximum and B the minimum changes that take place between the ages of twelve and twenty-one years. The growth and change of form of the alveolus in each case are more clearly shown by comparing the relative shape and position of this

B

A

tissue at *a*, *a*, and *b*, *b*. The changes in the position of each tooth are shown by the position of the plain line as compared with the dotted. As will be seen, this change is principally in the dropping of its cutting edge from a point near *b*, the future margin of the socket, and the projecting forward of the crown, while the apex of the root continues to remain on or near a perpendicular line let fall from the position of the apex at the earlier age.

In reference to the force which largely determines the position of the teeth, Mr. Tomes says:—"When a tooth leaves its bony crypt, the bone does not at first closely embrace it, but its socket is much too large for it, and a very small force is sufficient to deflect it. And, indeed, a very slight force constantly operating is sufficient to materially alter the position of a tooth, even when it has attained to its full length." With this opinion all will probably agree.

In these changes, the movements of the teeth are generally confined to the crown portions, not affecting materially the apical parts. The alveolus, like nearly all other tissues, is sustained by use and diminishes by disuse.

It has been supposed that the jawbone and the alveolus are distinctly different tissues; that the latter is entirely a superstructure growing upon the jawbone, like moss upon a rock, but for a purpose; that the alveolus, when its mission for supporting teeth is fulfilled, disappears as foreign growth, or, as one author puts it, "It passes away like a tree, without disturbing the foundation upon which it stands." I think this lichen notion will in time become modified if not obsolete, for it appears that although different parts of the bone of the jaw have received separate names for convenience of histological explanation concerning dental developments,[1] the body of the jaw and the alveolar process, though originating from different causes, are evolutionary products, and at the present time are one and should be regarded as one bone developed by nature for the same purposes, the principal of which is to hold and masticate food. That there is a degree of permanence in the body which does not exist in the alveolar portion is true, yet, while the latter may be regarded as having a more provisional nature than the former, there is some reason for believing that it is not established now for the sole purpose of supporting teeth, and when no longer needed to be entirely removed by nature. There seems to be no room for

[1] See Paper by Prof. C. N. Peirce on "Function, its Evolution and Influence," in the "Dental Cosmos," July, 1886.

doubt, however, that the growth and shape of the alveolus are largely governed and materially modified by the presence of the teeth; and this fact is further supported by the change that takes place when the teeth are lost, a portion of it then passing away by retrogressive metamorphosis,—a form of change analogous to that which takes place in other tissues no longer exercised. But, in this second modification, there appears also to be another purpose, the process of change being a means to an end—that is, to refit the alveolar ridge to act as a substitute for the teeth. While there is a reduction in the quantity of tissue, the process

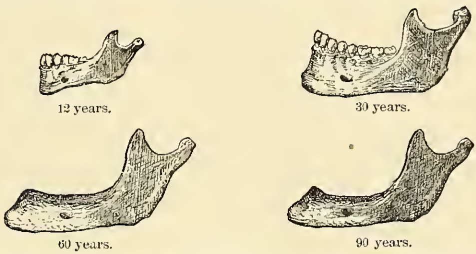


FIG. 49.—Four Jaws, showing the changes that take place between the ages of 12, 30, 60 and 90 years.

reshapes and rounds off the jawbone by removing the sharp edges of the sockets. This change, instead of reducing the entire ridge proportionally, is mainly confined to the thin parts or rims of the sockets, while the remaining portions are provisionally filled with new tissue, all being done as quickly as possible and in a manner which enables the bone to subserve in some degree the purpose of mastication.

Absorption of the alveolar tissue appears to continue through life; but the rate of absorption varies at different periods. Beginning immediately after the loss of the teeth it is rapid at first, and then becomes slower and slower with the advance of time, until the new provisional tissue above referred to, together with the remaining portion of the socket, but not all of the base of the alveolus, is obliterated. According to my observation, about as great a quantity of tissue disappears during the first three months after loss of teeth as in the twelve or fifteen succeeding months; and this amount, in turn, is about as great as takes place in the next seven or eight years; which, again, is perhaps as great as the reduction brought about in the next twenty or thirty years. Although this reduction is continuous, probably the time never arrives when such tissue altogether ceases to exist. The rate of absorption of the alveolus largely depends upon the relation of the edentulous ridges to each other. I have frequently noticed that if they antagonize all along the line they do not absorb as rapidly as when they do not: in some cases the change is scarcely noticeable in several years; but if the ridges do not meet except perhaps at some one anterior point or not at all, the reduction in size, as before said, is more rapid. Thus it appears that these changes are largely the result of the same kind of causes that lead to the wasting in the general system by lack of use and advance of age; hence the importance of early use of artificial dentures after the loss of the natural teeth. Although they will not stimulate growth of this tissue, their pressure upon it certainly retards absorption.

Are Teeth necessary to the Growth of the Jaw?—As the jawbone constitutes an integral part of the osseous frame of the body, whether teeth are present or not, its development is subject to the same law that governs the development of other bones, and this law controls it until the normal size is attained. It is true that, when teeth are present, the alveolar portion of the jaw is of greater size than when they are absent; but even when teeth have never existed, what is denominated alveolar tissue appears to exist in some measure. One author inclines to the belief that the size of the dental arch is not determined by the size of the jaw. Although this seems to be true in some cases, my observation teaches me that it is only partially so in most of them. But we shall have occasion to recur to this hereafter.

Among the adult cases that have come under my notice, in which a greater or less number of teeth had failed to appear, and in which there had never been any indication of their existence, is that of a woman about forty years of age, whom I have known from girlhood, who never had more than six teeth, and yet there appeared to be no lack of development of the body of the jaw. More remarkable than this are two entirely edentulous cases, which were seen by Prof. S. H. Dickson, M.D., L.L.D., and described by him to the class in Jefferson Medical College (1864-5). In neither case did he think there was any appreciable lack of development of jawbone. Dr. Guilford mentions an edentulous case, that of a man over fifty years of age now living in Lebanon, Pa., who never had a tooth in his life, and yet his jaws "do not differ in appearance or form from those of any individual whose teeth had been extracted years before."[1] If, in such prenatal cases, the jawbone had reached its normal development, what becomes of the notion that the premature loss of two or three deciduous teeth causes shrinkage of the jaw? (On loss of adult molars, see p. 582.)

Dr. Tomes mentions having removed all the deciduous teeth at one time without detriment to the growth of the jaw, or to the orderly appearance and arrangement of the second set. That the growth of the bone may possibly be affected by the absence of teeth is not denied; but, if affected, it is in such slight degree that, if the influence could be felt by descendants, the rate of change would be so slow that it would probably require many generations to cause any

[1] "Dental Cosmos," March, 1883.

material alteration of form or size. In short, I think that it is doubtful whether the mere absence of teeth would ever materially affect the size of the jaw, because the influence of the same functions that are exercised in mastication with teeth would still continue to be felt by the jawbone if there were none : in the latter case the general exercise of the jaws would, in fact, probably be increased, and this circumstance would tend to prevent arrest of growth.

Deformities by abnormal growth of portions of the jawbones sometimes arise from disease, general or local, such as leads to softening, tumors, etc. But although it might be interesting to study these various causes from the point of view of pathology and general surgery, they hardly belong to the phases of etiology now under consideration, *i. e.*, to causes existing within physiological conditions, and those so nearly allied to healthy conditions that they may be regarded as physiological. The difference between such causes and those that are pathological may be illustrated by cleft palate and tumor.

CHAPTER VI.

INFLUENCES OF EVOLUTION UPON THE JAWS.—OF PREMATURE EXTRACTION OF DECIDUOUS TEETH UPON THE SECOND SET.—OF PRESENCE OF DECIDUOUS TEETH UPON THEIR SUCCESSORS.

THAT the jawbone would become somewhat smaller in succeeding generations, which live on "soft food," requiring no exercise of the masticatory functions, is quite probable; in fact, there is very strong evidence that this change has occurred. To this it is thought by scientists is to be attributed the superiority of the human face in the civilized over that of the barbarian races, which feed upon roots and tough raw meat. But that this reduction in size of jaw has approximately run its course in the superior races, there are also cogent reasons to believe.

Some person, I think it is Mr. Cartwright, has suggested that selection may have had considerable influence in the reduction of the human jaw. That beautiful women have been chosen for wives in preference to the ugly is quite natural. If the birds and the brute creation manifest this preference, as urged by Darwin, why not man?[1] And if this be granted, all things being equal, why should not the offspring in time inherit beauty? I say "all things being equal," for unless proper habits, food and environments are considered, there would be room for qualifying argument.

As previously stated, the cause of the too small size of the jaw appears to be either the arrest of its growth, or trans-

[1] See some interesting papers by Dr. C. C. Abbott mentioned in "Popular Science Monthly," p. 547, Vol. XXX. (1887).

mission of likeness from some progenitor. If the latter be the case, it may be a phase of what evolutionists call Reversion. This hypothesis, however, is based upon the idea that the jaw is as distinctive a feature as the nose or eyes, and that the size of any of these does not depend entirely upon the size of other parts of the head. Amongst inherited causes of smallness of jaw may be mentioned the influence, not as yet clearly proved, of parental deterioration from mental overstrain, insanity, or idiocy. This subject will be mentioned again in its appropriate place.

Influence of premature Loss of Deciduous Teeth upon the second Set.—If the presence or absence of teeth has little or no influence upon the growth of the greater portion of the jaw, generally denominated the body, the hypothesis that irregularities are sometimes caused by its shrinkage rests on slight foundation; but since irregularity exists, there must be some cause for it, and as shrinkage of the jaw does not sufficiently explain it, we must seek elsewhere for a reason. If the growth of every part of a child's jaw—the body and that which develops into the alveolar ridge—be normal, and the germs of the teeth lie nearly or quite in their correct positions, each tissue being properly developed, if the deciduous teeth be not retained too long, then, as a natural consequence, the second teeth will appear in regular order, and will be arranged on the natural esthetic principles. There is some evidence, however, that premature extraction may cause a partial arrest of the growth of the shell-like portions of the alveolar ridge where teeth formerly existed, which will sometimes lead to irregularity of the second teeth; but instances of this are rare. But irregularity may occasionally be accounted for in some degree by tardiness in the growth of the jaw, associated with full development of the teeth. When this occurs, it has nearly the same effect as when a small jaw is inherited from one line of parentage and large teeth from the other. The crowded conditions resulting from tardiness are sometimes corrected by further growth of the jaw and alveolus, but this cannot be depended upon, as growth in the length of the jaws is mostly confined to the posterior portions.

Insufficient space usually implies an abnormal lack of alveolar tissue, but this is not always the case, for irregularities may be caused by unusually large teeth. In succeeding chapters the natural law governing the harmony of parts will be discussed at some length; but it may be mentioned here that the mingling of anatomical proportions, resulting from the crossing of types, produces parts by no means harmonious. Dr. Guilford says that "the teeth of giants are generally large and those of dwarfs small," but my observations do not confirm this statement.[1] I have noticed that although the teeth of giants and dwarfs in some slight degree approximate the proportions of the body, they are seldom, if ever, proportionate in size. Instead of generally finding large teeth in people of large stature, and small teeth in people of small stature, exactly the opposite quite often occurs. In most cases, the disproportioned teeth, though usually found to correspond nearly with the normal size of the teeth of one of the parents, sometimes seem monstrously large in the offspring. Unusual size occasionally appears to be due to reversion; but whatever be the cause, irregularity sometimes results from the too large size of the teeth as well as from the too small size of the jaw.

The largest teeth that I ever saw were in the mouth of a physician, a man of medium size. These teeth, which were regular, did not appear to be abnormal or in any way monstrous; still, all the teeth were very large, more especially the cuspids, the necks of which were as large as those of medium molars. Subsequently the children of this gentleman were

[1] "American System of Dentistry," p. 412, ¶ 4, Vol. III.

brought to me for correction of irregularities, which doubtless resulted from the inheritance of the small jaws of the mother with teeth of nearly the same shape and size as those of the father. The treatment of all these cases was similar —extraction of a sufficient number of teeth to make room for the remainder.

It may be doubted whether it would be possible to clearly prove an instance of want of proper size of the jaw due to tardiness alone. The cases of dwarfs, in whom the insufficient size of jaw is a result of the general arrest of growth of the system—although usually presenting, so far as I have examined, a lack of room for some of the teeth, as in the case of "Tom Thumb"—do not properly come under this head, because of the general harmony of all parts excepting the teeth, which are always of nearly or quite full size.

In some cases of irregularity, the evidences of cause point strongly in the direction of prenatal misplacement; but if the germ is originally in its proper starting-place, and it makes its appearance out of order, owing to its being diverted along the line of least resistance—as, for instance, when a tooth that would naturally move along the proper course is turned aside because of the persistent presence of some deciduous tooth, which, locked between other teeth, has not been able to dislodge itself—this cannot be regarded as a case of prenatal misplacement. But if, in its germinal period, a tooth accidentally starts wrong, it may travel and break out alongside the deciduous tooth.

The wasting of the root of a deciduous tooth, a physiological act, progressing, as it usually does, immediately before and in very close proximity to the advancing tooth, yet not in contact with it, leading to the final dropping of the crown of the deciduous tooth, is evidently an act on the part of nature for the accomplishment of one purpose, the exchanging of a more perishable instrument of mastication for another more dúrable. It must be admitted, however, that notwithstanding this seems to be a provision for the purpose of clearing the track for the successor, the retrogressive changes take place sooner or later in the deciduous roots, even when there are no successors. But, while this change requires a longer period of time, the more rapid rate in which the changes take place in deciduous roots, when followed in the line of their long axis by the development and advance of successors, is evidence, almost proof, that the latter has a powerful influence in hastening the waste. This evidence of a physiological act is supported in a negative manner by the slower changes that correspond to the distance or range over which the influence of the successor is felt, whether it advances far behind or to one side of the deciduous tooth, as also by the cessation of retrogressive physiological action, when the pulp of the deciduous tooth is dead, and the root is bathed in pus.

Beginning with the first molars, the second upper teeth generally appear in order, as follows: first molars, centrals, laterals, first bicuspids, cuspids, and then the second bicuspids, after which follow the second and third molars. The eruption of the cuspid, however, is sometimes simultaneous with that of the first bicuspid. The eruption of the lower teeth has in the text-books generally been erroneously given in the same order. But while, in exceptional cases, the lower teeth do appear in the same order as the upper teeth, the order is usually as follows: first molars, centrals, laterals, cuspids, first bicuspids, second bicuspids, second molars, third molars. These cuspids and first bicuspids also often appear simultaneously.

Influence of the presence of Deciduous Teeth upon their Successors.—Conceding that there may, in some cases, after premature extraction, be apparent evidence of slight shrinkage of the alveolar ridge, or more probably of arrest of its growth, experience shows that there are other and more potent causes of irregularity. The tendency of a side tooth is to move forward when not prevented by contact with a tooth anterior to it, or by the lock of the cusps of an antagonizing tooth. This being a fact, it will be seen that as the first upper bicuspid breaks through the tissues before the cuspid, it will, in case the deciduous cuspid is lost, be liable to move forward, and encroach upon the domain of the cuspid of the second set (which is still inclosed in the alveolus), and thus force it to appear in an abnormal and irregular position. Nor would the consequence always be different if all the deciduous teeth should be extracted at one time, for the free growth of the teeth in a wholly unoccupied space would naturally permit the first bicuspid to take its place anteriorly, perhaps nearly or quite in contact with the lateral incisor.

Much has been said and written about the influences of deciduous teeth upon their successors. It has even been debated whether the too long retention of the former is the cause of the irregularity of the latter, or whether the latter, being originally abnormally located, permits the retention of the former; but that roots of the deciduous teeth sometimes prevent eruption of their successors, is not disputed by any good authority. Whatever conclusion may be arrived at upon the first two points, it is an indisputable fact that some teeth are located in abnormal positions from the beginning, as proved by those cases where they have made an eruption through the cheek or roof of the mouth (see Figs. 42 and 44, from Magitot); and it is also a fact that, when some teeth of the second set appear on one side of their predecessors, if the latter are extracted, the new teeth will quickly fall into line, if there is sufficient room for them to do so. (See Part upon Extraction.)

CHAPTER VII.

POWER OF HEREDITY.—VARIABILITY OF FORM.—INFLUENCES OF INSANITY AND IDIOCY UPON THE TEETH.—INFLUENCE OF CHANGED CONDITIONS.—CROSSING OF DIFFERENT TYPES.

WE have now arrived at the question of the influence of Heredity. This, like many other topics connected with it, is an open field upon which many battles have been fought. It is, however, a fact recognized by nearly all observers that peculiarities of structure in individuals are transmitted to their offspring, and that this power of transmission is strong enough to be felt through several generations; but it is also well known that this influence is not in all cases permanent. If the result of the influence is evil, the peculiarity may gradually lose its power, and finally disappear, or it may acquire more strength, and in the end become so detrimental as to be incompatible with the continuance of life, and thus vanish in the extinction of the line. That heredity sometimes influences the arrangement of the teeth admits of no question; but some results have been attributed to heredity that more probably were due to extraneous causes, possibly only apparently repeated in others; mere coincidences. The consequences of traditional practice in some families have also been classed as inherited deformities. That one child out of six had an arrangement of teeth similar to those of a grandparent, when all other intermediate members of the line had regular teeth, is an evidence of inheritance not very unlike that by means of which I once heard a man claim that a wart on the top of his head was inherited because one of his parents had a wart near the same place.

An irregular arrangement of teeth that may be called typical of the family line, is an incident so frequently observed as not to admit of denial; but to stamp as inherited all abnormalities, instances of which have been occasionally noticed in a family line, is to assert that which cannot be scientifically supported. I have seen protrusion of the upper teeth recurring occasionally in certain families, but how far this was attributable to a habit practised from generation to generation of inducing the children to sleep by allowing them to suck the thumb or a hard artificial nipple, and persisted in until nearly of adult age, is a question worthy of consideration; because everybody of extensive observation knows that such practices do occasionally cause this deformity. Is it not possible that this transmitted habit may have as much to do with the protrusion of the teeth as some other transmitted influence?

While on the subject of protruding teeth, mention may be made that the peculiarity in some cases has been attributed to the practice of giving uncomminuted meat as an habitual article of diet to children at a time when, from decay or loss of the side teeth, the strain of mastication falls on the incisors before their roots are fully developed, and when the alveolus has not acquired sufficient hardness to firmly hold the developed portions, the result being that the crowns are pushed forward. If this be the case, it is another illustration of improper parental teaching and not of an inherited tendency to protrusion—a result of the same kind of force as from the use of hard artificial nipples. A child with such teeth, if fed on soft food, requiring no effort to masticate, would probably exhibit no protrusion.

Mr. Tomes apparently believes that the cause of defect in the development of the jaw cannot be regarded as so much the consequence of transmitted tendency as that of accidental forces peculiar to the individual, aided by extraneous causes acting upon the teeth during the period of eruption. This is probably true. The transmission of a defect does not appear to be due to exactly the same law of heredity as that which governs the typical form and features of a race sound in body and mind ; but a defect may creep in and require the careful efforts of two or three generations to eradicate it.

Although congenital malformations are to be seen everywhere throughout living nature, in the vegetable as well as the animal kingdom, congenital defects are not all transmitted nor are they all transmissible; therefore, in pronouncing prognosis, it is well to speak guardedly in consultation, and not permit the idea of inheritance to cause unnecessary apprehension. When several members of a line have shown a similar peculiarity, and no extraneous cause can be discovered, the peculiarity may, with some reason, be regarded as inherited, but not necessarily typical. When peculiarities only occasionally occur, especially if the cases greatly vary in character, it is much more probable that they are accidental, and date back only to a defective ovum, or are caused by unfortunate environments at this or at a later stage. While there is an engrafted tendency in all organized bodies to reproduce themselves, sometimes including anatomical defects, it is equally true that there is a more potent law, the tendency of which is to eliminate defects that are not common to the line. When, however, a peculiarity is found in a large majority of the members of a family, whether it has the appearance of deformity or not, it may reasonably be regarded as typical, and the peculiarity may not be easily eliminated. Hence, if there is any obstinate peculiarity of the teeth, the advisability of an attempt to correct them may be questioned ; for, unless the teeth be artificially retained in their new positions for a long time, perhaps for several years, they will not remain in place when liberated. By this I do not imply that such cases should never be treated. Where the deformity is so great as to render personal appearance very objectionable, I think that the operation should be performed even if it necessitate the use of a retaining device for a life-time. Thus it will be seen that the prognostic question as to the time necessary to retain teeth in place, artificially, is not always easy to answer; nor does it follow, as experience shows, that because some cases require such supporting aid for a long period that the deformity was inherited, much less typical. This is shown by numerous instances of deformities of the jaw and alveolar ridge of a kind not found elsewhere in the line. Defects of form are not necessarily typical peculiarities of a family.[1]

The confounding of esthetic notions with the typical forms of a race, by placing beauty as the highest evidence of perfection, often causes a confusion of ideas on this subject. A type may be perfect in itself and yet not be beautiful as a whole. The horse and the dove are acknowledged by all people of taste to be beautiful, because the different parts are in harmony with each other, while the hilly-backed camel, and the giraffe, with its short hind legs and extremely long fore legs, are ungainly because they seem to us inharmonious. The kangaroo, with legs built in proportions the reverse of those of the giraffe, appears grotesque, as he moves his long hind legs by using his short fore legs as crutches, aided by a huge tail, made to serve as a fifth leg; yet the camel, giraffe, and kangaroo should not be regarded as imperfect types because they are ungraceful in form.

It is a trite remark that "every eye forms its own beauty." Different individuals and races have different ideas as to what constitutes beauty of human form, but

[1] See Retaining Teeth in Position, Part XX, Vol. 2.

admiration of the typical aspect of a race does not prove that our views as to what constitutes beauty are correct. The majority of the Africans and Chinese, for example, have faces so typical that an individual of either race may be distinguished from all other races wherever found; and yet the thick lips of the African and the narrow eye of the Chinese, set at an angle inclining upward, would not be regarded as desirable models to follow in sculpturing a companion piece for the famous representation of the Greek type, the Apollo Belvidere.

Variability of Form.—The outward form of man, as well as his mental characteristics, notably varies in some degree from one generation to another. These elements and variations, too complex to be followed out, have been shaped not only by visible conditions but also by some that are invisible, which, when combined, produce results quite different from the original forms. Thus, as every generation is the fruit of double the number of parentage of either parent, it will be seen that this union of streams of inherited tendencies, together with the influences of the ever-varying surroundings, presents complexities and difficulties that are well calculated to confuse the mind of the calmest and keenest searcher after truth. Notwithstanding that this multitude of causes produces varying results in proportion, in shape, and in complexion, all the human races are found to resemble each other to a marked degree in numerous points. It has been stated that not only are there no two faces exactly alike, but that the shape and location of the features of the opposite sides of the same head differ more or less. However strange this may at first appear, the wonder increases when it is known that it has been established that even variations in the conditions of parents are sufficient to cause variations in the offspring; and that variability in shape or size is not confined to the outer forms. Wolff, the celebrated anatomist, a century ago, wrote a treatise on the numerous variations of the internal organs.[1] In the words of Darwin, referring to this author, "A discussion on the beau-ideal of the liver, lungs and kidneys, etc., as of the human face divine, sounds strange in our ears." These variations are not confined to the organs; even the positions of the organs are different in different people. I once saw a man whose heart was located in the middle of his chest, directly beneath the sternum. The arteries and muscles are found to vary in position; the main arteries so frequently lie along abnormal tracks that surgeons have found it necessary to make allowances for the possibility. Twelve thousand bodies have been examined with the view of ascertaining the average proportion of variation.[2] Mr. J. Wood mentions in the Proceedings of the Royal Society[3] that 558 variations of the muscular system were found in thirty-six bodies, counting both sides as one; he also says that in this set of bodies (which is only one of several sets) "not one was found totally wanting in departures from the standard description of the muscular system given in anatomical text books," and he further mentions the astonishing fact that in one of these bodies were found twenty-five abnormalities.

Question of the Influences of Insanity and Idiocy upon Teeth.—Hereditary insanity, idiocy, and the influence of mental overstrain, leading to impairment of energy and disturbance of nervous equilibrium, before referred to, have all been suggested by different writers as causes of irregularity of the teeth. To deny the great influence of disease through heredity upon offspring would hardly be regarded as possible by any person who has given the subject even a

---

[1] Act. Acad. St. Petersburg, 1778, p. 217.

[2] R. Quain, "Anatomy of the Arteries."

[3] 1866, p. 228; 1867, p. 544; 1868, pp. 175–189.

casual investigation.[1] The laborious arguments of different writers are so various as to confirm, not remove, the doubts that surround the question. For instance, Dr. Langdon Downs, connected with the Earlswood Asylum (London) for Idiots, says, in a paper read (1871) before the Odontological Society of Great Britain, that his examinations of a large number of idiots showed with few exceptions that the dental arch between the bicuspids was narrow, with deep palatine arch, and that irregularity of the teeth was very general among this class of patients, many of them having teeth so crowded that they stood on different planes, and the cuspids and the incisors were often very prominent. Dr. W. W. Ireland, in a similar examination, found that in eighty-one idiots examined, thirty-seven, or nearly half, had either a vaulted or a V-shaped arch. On the other hand, Dr. J. W. White and Prof. Stellwagen, upon examination of one hundred and eighty-four feeble-minded children of both sexes, noticed that large, well-shaped jaws were the rule and not the exception; that they would "compare evenly with the same number of similarly neglected people of ordinary intelligence."[2]

Upon the question whether the influence of the brain or nervous centres acting through the nerves from these centres could be ascertained by examination of idiots and lunatics, I intended to dwell at considerable length; but the investigations thus far made by others, as well as my own observations, have resulted in such conflicting testimony that I am obliged to admit that conclusions are too difficult until more definite light is thrown on the subject.

In a paper read at the Ninth International Medical Congress, Dr. Eugene S. Talbot showed the result of his investigation among 1,605 cases in which he was aided by

---

[1] See article by George J. Preston, M.D., on "Hereditary Diseases and Race Culture," in Popular Science Monthly, Sept., 1886, p. 639.

[2] Dr. James Truman is of the same opinion, so far as the blind are concerned.

Drs. S. B. Palmer, J. C. House, C. E. Estabrook, E. J. Ramhofer, S. T. Clements, H. M. Greene, Bryant and Hurst, in eight different Institutions for feeble-minded people, to be as follows:

DR. TALBOT'S TABLE, SHOWING THE TOTAL NUMBER OF DEFORMITIES IN THE JAWS OF BOTH SEXES IN EACH GRADE.

Sex.	Number.	Normal.	Large Jaw.	Protrusion Lower Jaw.	Protrusion Upper Jaw.	High Arch.	V-Shaped Arch.	Partial V-Shap'd Arch	Thumb Sucking.	Saddle-Shaped Arch.	Small Teeth.
HIGH GRADE.											
Male....	225	115	21	5	21	61	11	30	2	38	7
Female..	175	101	11	8	9	40	13	9	5	20	8
Totals....	400	216	32	13	30	101	24	39	7	58	15
MIDDLE GRADE.											
Male....	374	246	10	15	13	32	21	39	1	26	11
Female..	274	183	10	6	6	19	12	43	5	19	12
Totals...	648	429	20	21	19	51	33	82	6	45	23
LOW GRADE.											
Male....	214	72	20	15	24	46	27	34	7	29	9
Female..	343	207	15	14	24	40	17	45	11	27	9
Totals...	557	279	35	29	48	86	44	79	18	56	18
Total of all the above Totals..	1605	924	87	63	97	238	101	200	31	159	56

In a paper read before the Odontological Society of New York, I think in 1876 or '77, the substance of which may be found in his "Oral Deformities," Dr. Kingsley dwells at considerable length upon this point, but some of the conclusions there drawn seem to me to be imperfect. An eminent authority referring to this matter has made the remark: "I fail to see that he has, in referring back irregularities to disturbed innervation, done much in clearing our notions of their *raison d'être*, even granting that his point were proven, which I do not think it is."[1]

That there is some correlation between protruding front upper teeth and some peculiarity of mind in cases where the forehead recedes, my observation leads me to believe is true, but that this correlation exists between protruding upper teeth and the brain, where the forehead is full, is not established, according to my experience. In regard to the lower jaw, there seems to be a correlation between oddity of mind and a very receding jaw, that is deficient in the prominence called the chin. As to narrow as well as V-shaped jaws, I find that if there is any correlation, it is rather with a highly nervous organization than with idiocy. In fact, I have not found strong evidence that idiocy has much to do with this conformation; on the contrary, those people who have narrow or V-shaped arches are often mentally bright and active, even if not physically strong. I am now engaged in regulating the teeth of such a case, the patient being a lady of more than ordinary intelligence. To assert, however, that there is absolutely no relation between the narrow and the V-shaped arch, and a tendency to insanity through a highly nervous parental organization, would be contrary to the evidence.

The statements made are not intended to show that I doubt the discoveries or conclusions of the different British investigators, for although my observations in the United States coincide with those of some of the American gentlemen above mentioned, it is quite probable that there may be an

[1] "Tomes's Dental Surgery," p. 186 (1887).

element not now even foreshadowed which, when discovered, will be sufficient not only to harmonize these diverse views, but to place the subject in so different a light that the present appearance of a conflict of evidence will pass away and the varying observations will be found to support each other. Credit should be given to all persons who undertake such investigations for scientific truth, for whatever is ascertained by them, whether for or against preconceived ideas, the result is of nearly equal importance. Indeed, negative evidence is often of as much value as positive, even if it be only to aid in eliminating errors by the "process of exclusion," thereby bringing the consideration of the question within the limits of a discussion of facts.

Influence of changed Conditions.—Changed conditions, among which are included occupation, climate, air, and altitude of location, are sufficient to cause an indefinite amount of fluctuating variability in the entire human system. This is universally conceded, and is particularly shown in the change in the length of the arms and legs and girth of chest described by Gould and other writers.[1] But it is extremely doubtful whether these changes of condition, which are necessarily very slow, have much if anything to do with causing irregularities of the teeth. Especially does this negatively appear doubtful when we discover that parents and more remote progenitors living in unchanged conditions, and having regular teeth, sometimes find striking irregularities of the teeth in their children. Still, if variation in the size of parts, caused by exercise or lack of exercise, can in time establish such an influence through heredity as to permanently reproduce modifications, as sug-

[1] B. A. Gould, "Investigations in Military and Anthropological Statistics," 1869. M. J. P. Durand, 1868, "De l'Influence des Milieux." C. Darwin, "Variations of Animals and Plants under Domestication," Vol. II.

gested by Rengger[1] and others—if the old belief be correct, that the hands and feet of those races of man which have for many generations been accustomed to manual labor are larger than the hands and feet of the races which have not thus labored—then it seems possible that the jaws may indirectly be slightly influenced by similar causes, and thus indirectly lead to dental irregularities. The process of change is, however, not the same in kind as that described by one writer, who attempted to show by metaphysical argument that keeping the human hair very short all over the head, in the "convict" or "anti-vermin" style, would in time result in destroying the growth of hair, and that the cutting off of the tails of dogs for several generations would finally produce a race of tailless dogs. This argument is not supported by the results of the circumcision of the Israelites for four thousand years, nor of the shaving of Chinese heads for six thousand.

While it is true that a gradual recession of the jaws has taken place from ancient times to the present, it should be remembered that the great difference of profile between the ancient and the modern face is a relative appearance, brought about not only by changed conditions, including food, but largely by the development and growth of the brain, which has caused the frontal bones to project over the jaws, and at the same time to draw the nasal bones forward.

While there is what may be called a law of growth that tends to harmonize the relative size of the different parts of the body, there are also counteracting influences, or, in other words, habits and customs, or a mingling of conditions that, through partial arrest of development or of growth of some parts, tend to alter the proportions, but change in this respect is not necessarily, esthetically speak-

[1] Säugethiere von Paraguay, s. 4, 1830.

ing, a disadvantage. If, by the development of the brain, its bony envelope is pushed forward, causing the forehead to project beyond the angle common to earlier progenitors, that is no reason why the jaws should also grow larger. On the contrary, the greater intellectual grasp and deeper knowledge resulting from the enlarged brain, enabling the moderns to live with less labor than the ancients, together with the use of cooked instead of raw food, requiring less vigorous exercise of the teeth and jaws—the same law that induces atrophy and reduction of size, from non-exercise—would tend to diminish the growth of the lower portion of the head in about the same ratio that the upper is increased, and, consequently, up to a certain degree of change, the head would appear more beautiful, not less so. I say "up to a certain degree," because if the cerebral portion of the head should grow too large, resembling in outward appearance extreme cases of hydrocephalus, the symmetry, as pronounced perfect by artists, would be destroyed as truly as it is in the case of a sloping forehead and projecting jaws.

I have alluded to this point because some writers have oddly attributed the too small size of the upper maxilla to a want of blood supply and insufficient exercise of the jaw, resulting from its stationary condition as compared with the lower jaw which, as they appear to regard it, is not often found too small. The premises here do not seem to me to warrant the conclusions. It is hardly possible that the upper jaw can have become less than the lower from these causes, because the decrease of use is the same for both jaws. The mere passive mobility of the lower maxilla cannot promote its growth, and when the force of blows of the teeth is considered, it is the same for both. The anvil receives as much force as the hammer. If the hypothesis referred to were true, it would equally apply to the jaws of the animal kingdom, a supposition which facts do not support; on the contrary, the relative size of the jaws is found to be about right for efficient mastication.

From my own observation I incline to believe that by far the great majority of cases of deformity in the arrangement of teeth exist from one or both of two principal causes, a primary and secondary, the former being pre-natal defect, the latter neglect. The former are due to the crossing of different types, leading to deficient alveolar substance; accidental occurrences during gestation leading to defective or incomplete development of the jaw, or to derangement and misplacement of the germs of the teeth, so that they appear in wrong positions; defective ovum, leading to fractional monstrosity, is also found here as in other parts of the body. These are natural defects.

The secondary causes are premature or too late loss of some of the deciduous teeth; permitting more of the second set to remain in the jaw than it can accommodate; and improper antagonism. These influences may be called mechanical.

Crossing of Different Types.—It has been said that there is a law of generation that sometimes leads to reproduction of size of parts from one parent independently of fitness to the parts inherited from the other. This refers to the fact that the averaging of different parts of the system is not as constant as we would naturally expect. We have already mentioned as an instance the very large teeth that in size and shape were like those of one parent, in small jaws that were like those of the other parent. This seemingly esthetical incongruity is not to be classed under the same law that marks prominent features in a family,—for instance, the large nose of the Napiers.

This is more persistently shown in the Hebrew race, probably from the fact that they have remained a distinct people from time immemorial. Such a feature cannot be strictly regarded as incongruous ; but when a person inherits a lilliputian stature from his mother and colossal teeth from his father, such an unbalanced relation must be viewed as inharmonious, and certain to lead to deformity in the ar-

FIG. 50.—Napier.

rangement of the teeth, because of lack of alveolar space. But, however unbalanced the parts may be, the law already mentioned, though slow of action, tends finally to reduce inherited incongruity to harmony in the course of generations.

The term *type* (of the shape or form of a human being) as recognized in dentistry, as well as in painting and sculpture, is arbitrary. It is not based upon that (type) of the earliest progenitors of the human race having uncouth forms, with long, narrow and angular jaws, but the type finds its base in the most improved forms developed by nature in the ascent of man and presented to us by the laws of evolution.

In regard to the dental arch, the types of form recognized by artists are based upon that which combines utility and beauty ;—upon that which combines an arrangement of the teeth, efficient in the proper mastication of food, with a facial outline which is most becoming to the individual. This subject will be elaborated in Part XXI., Vol. 2.

CHAPTER VIII.

INTERMINGLING OF RACES.—RANGE OF SIZE OF JAW.—CHARACTERISTICS MIX, BUT DO NOT READILY BLEND.

WHILE there is much truth in the remarks of an accurate observer (Francis Galton) that "Men have long been exempt from the full rigor of natural selection, and have become more mongrel in their breed than any other animal on the face of the earth," yet it is a fact that old nations that have lived within themselves for a great length of time, and that seldom intermarry with people of other nations, are generally harmonious in their anatomical structure, thus teaching the advantage of marriage within the same type. The teeth and jaws of Italians are seldom irregular; the same may also be said of the Chinese. Wherever there is the crossing of types, so common in the United States,—a nation made up of all nationalities,—irregularity of teeth naturally follows. Where the laws of generation are not observed, financial and social position and blind fancy are the incentives to marriage, leading to the mingling of different nationalities, types, sizes, temperaments and conditions; the result is the same as that which takes place after the conquest of a country by a foreign power. Races and types are soon mingled and crossed by intermarriage. Perhaps there are no better illustrations of this mixing of types than the people living on the borders between different nations. The women of Albania and those of Biscay and Galicia, who from religious scruples and national prejudice decline to intermarry with their neighbors, are much more beautiful than those of Piedmont, and Friuli. The Egyptians, who have suffered many invasions, have lost more of their original type of feature than the women of Abyssinia, who are seldom troubled by such vicissitudes. In parts of New England, prior to 1850, when there was but little mixing of other nationalities with the Puritan stock, the relations of the jaws were in better proportion with the other parts of the physique, and the teeth were more regular, than was the case in and about the cosmopolitan city of New York. The degeneracy in the teeth of New Englanders, at that time largely a result of overwork, and indigestion arising from heavy mid-day meals and light suppers, may, however, be regarded as worse for the people than that caused by the crossing of races.

Range of Size of Jaw.—The normal size of the human jaw in different races varies, but it is known that there is a limit within which this variation is generally confined. So far as my investigation extends, the smallest normal jaws are to be found in the small-sized races, among the mountains between Spain and Portugal, in Central America and among the Hottentots and Bushmen of South Africa; and the largest among the Feejee Islanders, Ashantees, New Zealanders and some African races. But, in all races, even when pure-blooded, there are exceptions to the general type. From a paper contributed by Mr. John R. Mummery to the Odontological Society of Great Britain, in which he gives the results of examination of about three thousand skulls of ancient and modern uncivilized races, ancient British, Roman British, Anglo-Saxon, ancient Egyptian, Australian, North American, African and Polynesian, we learn that the average width of the dental arch between the first molars of the ancient races was scarcely two inches and three-eighths, and that of the uncivilized modern races two inches and a half. The greatest average of arch diameter of any race given by Mr. Mummery is about two inches and three-fourths. To enable the reader to form an adequate idea of such an enormous jaw, and to show the wide latitude that is possible in the size of the dental arch, he is referred to the following figures, which are drawn from casts in my cabinet.

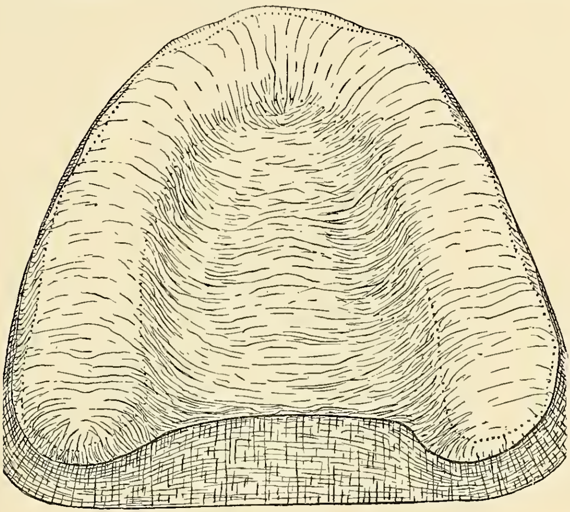


Fig. 51.—Upper Jaw of an African. Exact size.

Fig. 51 illustrates the exact size of the upper jaw of a negro. The tranverse diameter of this jaw, taken between the lingual walls of the first molars before the teeth were extracted, was about two inches and one-eighth. The measurement from the outside of the gums on this line is about three inches and one-eighth; between the lingual surfaces of the third molars about two inches and a half, measuring from the buccal surface of the gum across the posterior portion of the arch to a corresponding point on the opposite gum three inches and three-fourths. This latter measure-

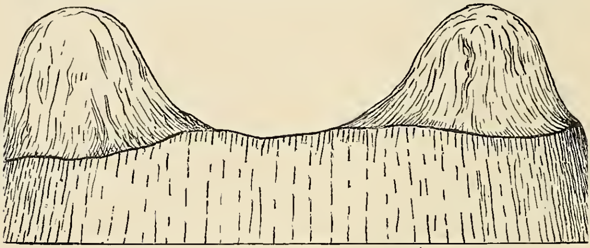


FIG. 52.—Posterior View of the Upper Jaw of an African. Exact size.

ment is not taken from a point high up on the gum where the alveolus widens out into the maxillary bone, but mid-

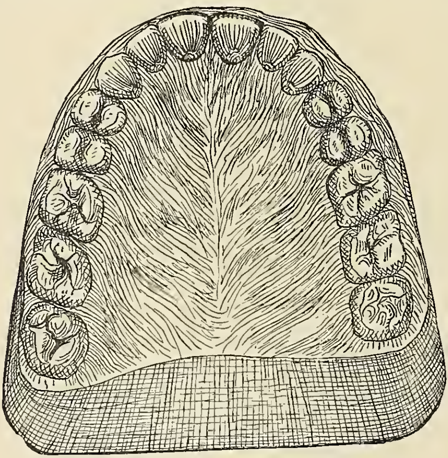


FIG. 53.—Upper Jaw of a German (Gallic arch). Full size.

way of the part containing the dental sockets. Fig. 52 illustrates a posterior view of the same jaw outlined from a piece of card-board, cut and accurately fitted perpendicularly to the surface of the cast.

Fig. 53 illustrates the exact size of what may be regarded as a large jaw. This is of a German, of robust, yet not colossal size. The transverse diameter of this arch between

FIG. 54.—Average size of a European Jaw (Latin Arch).

the lingual walls of the first molars was one inch and five-eighths, while between the buccal walls it measured two inches and six-sixteenths; the measurement between the lingual walls of the third molars was one inch and seven-eighths, and the distance between the buccal walls of the same teeth was two inches and seven-eighths.

Fig. 54 illustrates (what may be regarded as about) the average size of a European jaw.

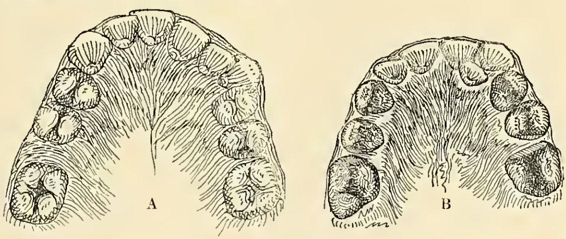


FIG. 55.—A, Upper Jaws of a Woman-dwarf, and B, of "Commodore Nutt" (both life-size).

Fig. 55 illustrates the upper jaw of two dwarfs. The woman was three feet and six inches in height and twenty-five years of age, and is now being publicly exhibited as a lilliputian. As will be seen, this jaw has lost both of its first molars, yet the remaining teeth are irregular. An older sister, who is also a dwarf of about the same size, has a larger jaw, but her teeth are even more irregular. In the case of "Commodore Nutt" the dental arch was considerably smaller than that of the woman dwarf, but the teeth were of about the same size as those of these sisters—that is to say, not much smaller than those of persons of average size. In the cases of the "Mexican Midgets," who weigh only four and five pounds each, the jaws are very small and the teeth soft and imperfect, resembling in size kernels of rice. Such cases as these, however, cannot be regarded as of much value to the subject of Etiology.

CHAPTER IX.

UPON THE QUESTION OF HETEROGENEOUSNESS IN THE MIXTURE OF RACES.—POWER OF HEREDITARY INFLUENCE GREATER IN THOROUGHBREDS THAN IN GRADES. —VIEWS OF HERBERT SPENCER.

UPON this question Darwin says: "When two races cross, the result is a heterogeneous mixture. Whether a heterogeneous people, such as the inhabitants of some of the Polynesian Islands, formed by the crossing of two distinct races, with few or no pure members left, would ever become homogeneous, is not known from direct evidence. But, as with our domesticated animals, a crossed breed can certainly in the course of a few generations be fixed and made uniform by careful selection, we may infer that the free and prolonged intercrossing during many generations of a heterogeneous mixture would supply the place of selections, and overcome any tendency to reversion, so that a crossed race would ultimately become homogeneous, though it might not partake in any equal degree of the characters of the two parent races." [1]

A comparison is sometimes made between what are called mixed races and thoroughbreds, but this classification should only be taken in a relative sense, as there is probably no strictly pure race of human beings upon the globe. Mr. John Reade, in an able paper on "Intermingling of Races," shows that the mingling of blood, instead of de-

[1] "Descent of Man," Vol. I., p. 232.

creasing, is rapidly increasing, and is destined sooner or later to amalgamate in one family most of, if not the entire human race. In Mr. Reade's words: "No sooner do we meet with evidence of racial diversity, than we begin to discover indications of race intermixture. The ancient Egyptians, who furnish us with such interesting examples of the human varieties of their time, were themselves a people of mixed blood. Nor in that respect were they singular. If, starting from that meeting-place of nations and tongues, the Nile delta, we traverse the adjacent continents to their utmost limits, everywhere on the route, from Aino-peopled Japan to the Pillars of Hercules, we shall be confronted by the testimonies of interfusion of blood. Even races that seem most homogeneous, like the Chinese, or that have taken pride in avoiding the taint of alien mixture, like the Aryan Hindoos, or, like the Israelites, who deemed themselves interdicted by the divine command from intercourse with foreigners, have been proved beyond a doubt to be of composite origin. To deal separately with those various families of mankind, as the dawn of history discloses them to us, or as the centuries of its short range have left them, would take up much time."[1]

This writer then quotes a passage from "The Human Species" by the distinguished ethnologist, M. de Quatrefages: "In China, and especially in Japan, the white allophyllian blood is mixed with the yellow blood in different proportions; the white Semitic blood has penetrated into the heart of Africa; the Negro and Houzouana types have mutually produced all the Caffre populations situated west of the Zooloos of Arabian origin; the Malay races are the result of the amalgamation, in different proportions, of whites, yellows, and blacks; the Malays proper, far from constituting a species, as polygenists consider them, are

[1] "Popular Science Monthly," January, 1887, p. 336.

only one population, in which, under the influence of Islamism, these various elements have been more completely fused. I have quoted at random the various preceding examples, to show how the most extreme types of mankind have contributed to form certain races. Need I insist upon the mixtures which have been accomplished between the secondary types derived from the first? In Europe what population can pretend to purity of blood? The Basques themselves, who apparently ought to be well protected by their country, institutions, and language, against the invasion of foreign blood, show upon certain points, in the heart of their mountains, the evident traces of the juxtaposition and fusion of very different races. As for the other nations, ranging from Lapland to the Mediterranean, classical history, although it does not go back for a great distance in point of time, is a sufficient proof that crossings are the inevitable result of invasions, wars, and political and social events. Asia presents, as we know, the same spectacle; and, in the heart of Africa, the Gagas, playing the part of the horde of Genghis-Khan, have mixed together the African tribes from one ocean to the other." [1]

Thus it will be seen that if race mixture is a cause of irregularity in feature or of abnormality in the arrangement of teeth, such influences must have existed from remote times. Therefore, although cases of irregular teeth were probably less numerous formerly than at present, it is not reasonable to infer that there were no cases of abnormality; nor does the fact that but few cases have been discovered among the ancient skulls as found in museums and churches prove that only a few cases existed.

On this subject the diversity of opinions is so great that it may be interesting to give the varying reports of some observers. Messrs. Cartwright and Coleman, as quoted by

[1] "The Human Species" ("International Scientific Series"), pp. 273, 274.

Dr. Tomes, report that they found no example of contracted jaws in the large collection of skulls in Hythe Church, skulls which are of undoubted antiquity, though of unknown origin. Dr. Nichols, who examined the mouths of Indians and Chinese in the Rocky Mountains, to the number of thousands, as he says, found but one case of irregularity. My own observation of the Chinese shows a much larger percentage of irregularities. The late Mr. Mummery made extensive observations among savage races, and reports that irregular teeth as well as narrow jaws were extremely rare.

Dr. Tomes mentions the skull of an Australian in the Oxford University Museum, in which the lower incisors are crowded, and says that close beside it is an orang in which the left second upper "premolar" is not erupted, though the dentition is complete, and the right "premolar" stands between the canine and the lateral incisor; also that there is in the same museum a gorilla skull, the lower jaw of which is somewhat contracted, so that the molars do not antagonize correctly. Dr. W. C. Barrett, who examined a great number of skulls in the Peabody Museum in Cambridge, Mass., gives some of the results of his observations as follows: "The upper floor of the museum contains nearly two thousand skulls, and the collection is especially rich in the remains of prehistoric American races. There are many skulls of moderns, but my attention was chiefly directed to those of the North American Indians, to those of the ancient mound-builders of the Tennessee region, to skulls found in ancient Mexican caves, to some from California, to a large number obtained from ancient burial-places near Ancon, Peru, to some other South American skulls, and to a collection of early Sandwich Island skulls. Besides this, I examined, as far as time permitted, some Roman skulls of the early Christian period. It will be observed that with the exception of the Roman skulls, and perhaps a few of the

North-Western Indians, the people of whom these bones were relics lived before the time of contact with the whites, and were therefore pre-historic. There were fewer irregularities among the teeth of these people than are known at the present day. Their jaws, especially those of the mound-builders, were broad and well developed, giving indications of a muscular race. Nevertheless, bad cases of irregularity were not absent. The teeth of the South-Western Indians were the most worn by use, and it was not unusual to find whole dentitions worn completely down to the gums."

Speaking of the early inhabitants of Peru, Dr. Barrett says: "In fifteen cases, out of two hundred skulls, there was no sign of the presence of wisdom teeth, nor of their loss. Seventy-two dentitions were extensively worn, some of them nearly even with what must have been the border of the gums. In five instances the wisdom teeth were in appearance but rudimentary. In eighteen cases teeth occupied an abnormal position through lack of room for their development, and this notwithstanding the usually massive character of the maxillæ. There were four cases of decided irregularity, not counting unimportant deviations from the normal." The same writer further remarks that "among the mound-builders there were fewer cases of irregularity than among the Peruvians," and that the "Sandwich Island skulls exhibited beautiful teeth, with very rare instances of irregularity."

If, then, irregularities occurred in remote ages, as seems to be proved, and are even found in the brute creation, it is not strange that with the great changes brought about by civilization through the use of different food, and the greater intercourse of nations, the number of such deformities is on the increase, or that they will continue to increase until either the science of breeding is studied and adhered to in the human race, or until amalgamation has evolutionized the different types into one. If, as it now plainly appears from all we have been able to gather, that nature is ever striving to reinstate harmony whenever and wherever she can ; it is probable when a number of peoples, including so many different types as does that of the United States, shall have become a homogenous race with a typical form, these irregularities and disproportioned parts will become balanced, and the jaws will be in proportion to the teeth. But, this result cannot be expected until the admission of different forms and elements shall have ceased. The union of different races, types, nationalities, physical characteristics as to size, etc., cannot but be detrimental to general harmony of structure in the offspring. That such unions do not bring about an orderly blending of the forms and qualities of the parents, but rather an apparently hap-hazard and often inharmonious combination of them, is too frequently noticed to need much argument. It is evident that if the types to which the parents belong were evenly represented in the child, the result would be that the characteristics would have been blended so as to render it impossible to determine which progenitor had had the greater influence in the development of the offspring, or, as Herbert Spencer expresses it, "If each organ or faculty in a child was an average of the two developments of such organ or faculty in the parents, it would follow that all brothers and sisters should be alike, or should, at any rate, differ no more than their parents differed from year to year. But so far from this being the case, we find not only that great irregularities are produced by intermixture of traits, but that there is no constancy in the mode of intermixture, or the extent of variation produced by it."[1] If the force of transmission operates in such promiscuous and apparently capricious fashion that we can occasionally

[1] "Essays; Scientific, Political and Speculative."

trace in present generations the influence of even remote ancestors,—mental and physical features, that have disappeared for a long time, reappearing with startling distinctness in a descendant of to-day, with no resemblance whatever to the immediate parents,—we can see in these facts the working of the general law that "an organism produced from two organisms that are constitutionally different is not a homogeneous mean, but is made up of separate elements, taken in variable manner and proportion from the originals."

Power of Hereditary Influence in Thoroughbreds greater than in the Grades.—It is well known by cattle-breeders that sometimes, after several generations in which no apparent changes were present, traces of a cross crop out. It has even been shown that a single crossing of a short-haired thoroughbred mare with a long-haired Canadian horse so affected the mare that her succeeding offspring occasionally present the characteristics of the Canadian horse, though the foaling has since been strictly thoroughbred. Mr. Spencer refers to an article[1] respecting the efforts at crossing of French and English sheep, which bears upon this question. It seems that various attempts had been made to improve the French breeds by the finer stocks of English sheep, without success. The crosses bore no trace of their English parentage, but continued as dwarfed as their French progenitors, until the cause was thought to lie in the relative heterogeneity of the constitution of one and the homogeneity of that of the other. The English sheep, though superior, were of mixed blood, while the French sheep were thoroughbred, so that the imperfectly balanced constitution of the English breed was not sufficiently powerful to sustain itself against the completely balanced constitution of the inferior French breeds.

To test this hypothesis, crosses were made with the mixed

[1] Quarterly Journal of the Agricultural Society.

English races by French sheep that were a mixture of two pure breeds, when it was found that the French sheep produced offspring in which the characteristics of the English breeds were strongly shown. This lack in ability of a mixed race to hold its own against an unmixed though inferior race accords with the above line of reasoning. By an unmixed constitution is meant one in which all the organs are exactly fitted to each other, so that the system as a whole is perfectly balanced. A mixed constitution made up of organs belonging to two separate sets, says Spencer, "cannot have them in exact fitness;" and the result is "a system in comparatively unstable equilibrium; in proportion to the stability of the equilibrium will be the power to resist disturbing forces. Hence, when two constitutions. one in a stable, the other in an unstable, equilibrium, become disturbing forces to each other, the unstable one will be overthrown, and the stable one will assert itself unchanged." His conclusion is that this want of equal force in mixed constitutions is the primary cause of differentiation into general, species and varieties. He points out that "if it be true that an organism produced by two unlike organisms is not a mean between them, but a mixture of parts of the one with parts of the other. . . . imperfectly co-ordinated, then it becomes manifest that in proportion as the difference between the parent organisms is greater or less, the defects of co-ordination in the offspring will be greater or less."

It has been accepted as a physiological fact that the crossing of some races cannot be carried beyond a certain point, varying according to the difference in the originals, from the second to the eighth generation. It is said that the intermixture of the negro with some white races cannot often be carried further than the octoroon; that some mixed races tend to extinction; and in the case of brutes, hybrids rarely reproduce themselves beyond the fourth or fifth generation.

If this be so,—and the facts seem well attested,—it is an illustration of the working of the law elsewhere referred to, of the tendency of nature to destroy the line, after failing otherwise to eliminate discordant or incongruous elements.

Spencer's Views quoted.—As Mr. Spencer's views, already referred to, are pertinent to our question, and as his opinions are regarded as of great weight, I feel it a duty to quote him more fully: "Between organisms widely differing in character, no intermediate organism is possible. When the difference is less, a non-prolific hybrid is produced, an organism so badly co-ordinated as to be capable only of incomplete life. When the difference is still less, there results an organism capable of reproducing itself, but not of bequeathing to its offspring complete constitutions. And as the degrees of difference are further diminished, the incompleteness of constitution is longer and longer in making its appearance, until we come to those varieties of the same species which differ so slightly that their offspring are as permanent as themselves. Even in these, however, the organic equilibrium seems less perfect. In connection with this inference, it would be interesting to inquire whether pure constitutions are not superior to mixed ones, in their power of maintaining the balance of vital functions under disturbing conditions. Is it not a fact that pure brute races are hardier than the mixed ones? Are not the mixed ones, though superior in size, less capable of resisting unfavorable influences, extremes of temperature, bad food, etc.? And is not the like true of mankind?

"It is manifest that the facts and reasonings given serve further to enforce the general truth, that the offspring of two organisms not identical in constitution is a heterogeneous mixture. If, then, bearing in mind this truth, we remember the composite character of the civilized races, the mingling in ourselves, for example, of Celt, Saxon, Norman, Dane, with sprinklings of other tribes; if we consider the complications of constitution that have arisen from the union of these, not in any uniform manner, but with utter irregularity—and if we recollect that the incongruities thus produced pervade the whole nature, mentally and bodily, nervous tissue and other tissues—we shall see that there must exist in all of us an imperfect correspondence between parts of the organism that are really related, and that, as one manifestation of this, there must be more or less of discrepancy between the features and those parts of the nervous system with which they have a physiological connection."

If Mr. Spencer's views are correct, and I think they are believed to be so by those best qualified to judge, there is an underlying power, a law, that tends to evolve order out of confusion not only in mental but also in bodily forms. If study of this law should find a place in the science of dentistry, it would contribute to an education that would lead to broader views, so that the profession would extend over a wider field than the filling of cavities in teeth, substituting artificial dentures or re-arranging irregular teeth simply for greater convenience at the table. These points are not undervalued, nor is the knowledge, that enables one to restore facial expression that has been impaired by the loss of teeth, held in light esteem. But, though important to health, these branches hold, as it appears to me, so far as knowledge is concerned, a subordinate position to that which will prevent, as well as correct, irregularities of the teeth for the benefit of facial expression.

In dealing with the various phases of the etiology of irregularities of the teeth, I have attempted not so much to trace out the complexity of cause and its bearings throughout the various ramifications, as to lay open to view the field of phenomena, in order that the reader may be stimulated to further investigation of this important subject, not only in the special line of deformities of the dental arch but in other phenomena in different parts of the system, for it is found that they are so intimately related that a key that unlocks one mystery will often serve to unlock others.

Whatever the cause of that deformity of the teeth called irregularity in a given case may be, whether inherited or accidental, it matters little so far as concerns the operation for correction, as in most cases the treatment is nearly if not quite the same. Yet it is well to study the causes, if for no other reason than to be able to explain them intelligently. Moreover, in proportion as the operator understands these complex questions is he enabled not only to know what can or cannot be accomplished, but to prognosticate nearer correct the degree of permanence of the results of his treatment.

PART IV.

Philosophy of the Author's System.

CHAPTER X.

INFLUENCE OF EXTRANEOUS FORCES UPON NATURAL FORM.—SURGICAL OPERATIONS.—ILLUSTRATION. THE EFFECT OF FORCE ON TEETH.—TEETH MOVED BY TWO KINDS OF CHANGES IN THE ALVEOLUS.—TISSUE CHANGES FROM THE MOVEMENT OF TEETH NOT NECESSARILY PATHOLOGICAL.

THERE is a law that governs the shape of things, yet there is a limit to the power of this law, and other forces may overcome it. A tree has its natural form, but a wind moving in one direction for a long time may cause it to lean or to grow one-sided; the branches facing the wind will not only be prevented from reaching out as far as those opposite, but where the wind has an advantage on the lateral branches, the side having the longer boughs will sometimes cause the trunk of the tree to twist. A persistent habit of pulling upon the skin about the throat will cause folds, and the applying the handkerchief forcibly to only one side of the nose will cause it in time to become permanently bent; so the teeth, by the application of improper force, may be moved out of line, and if the cause is allowed to continue, they will become permanently fixed in a wrong position.

It is by taking advantage of such effects of force that the dentist corrects irregularities of the teeth, the object being to remedy the overcrowded condition which causes caries, imperfect mastication, incorrect enunciation and deformity of feature.

It has been known from earliest times that a tooth would, although much out of line, in some instances, move imperceptibly into its proper place, apparently without cause; in other cases its movement might be hastened by frequently repeated digital pressure. This knowledge led to the conception of the idea, that by attaching something to the tooth to maintain a constant tension upon it, it would be compelled to move faster, an idea which, being tested by experiment, proved to be correct, but the physiological reasons for this result for a long time were not regarded as worth investigating, and even now are thought by many to be unimportant. In 1873, I attempted to draw attention to the matter by pointing out the value of taking advantage of a natural law which I thought should be especially observed by those who perform such operations in surgery or dentistry as depend on pressure upon the tissues, with the view of guarding against undue inflammation. I also dwelt upon the relative merits of the different principles upon which surgical apparatus was then constructed, more especially the devices for regulating unsymmetrically arranged teeth.

As is well known, in some cases the correction of irregular teeth is easy, causing little or no pain or inflammation; in others difficult, tedious, and accompanied by pain and inflammation. Are these differences owing entirely to a difference in the constitutions of the persons operated upon, or do they result from the manner in which the operations are performed? My object at present is to show that more depends upon the operator than upon the patient. It is easy to understand why any operation performed upon a scrofulous or anæmic person will not, as a rule, be followed by results as happy and speedy as would be the case if the patient were healthy; but other points which I propose to discuss are of greater importance. By a series of experiments I found that certain results appeared always to follow similar circumstances. In other words, "Like causes produce like results." Again, I found, as before implied, that the difference in results seemed to be due not so much to the different temperaments and conditions of patients as to the manner of treatment.

Surgical Operations.—These experiments led me to reflect upon various well-known surgical operations depending upon pressure, such as dilating strictures and ligation of tumors. At this time the operation for removing tumor by ligations, renewed from time to time, seemed to be regarded as depending upon strangulating the blood-vessels or lacerating the tissues and killing the tumor; finally, the sloughing off or the tearing away of the offending tissues; while the operation of reducing stricture depended in some cases upon the frequently repeated stretching of the tissues, in others it was based upon their laceration, by forcing through the stricture a smooth catheter and allowing it to remain until the tissues healed around it. Operations for correcting irregularities of the teeth were based chiefly upon the same principles, forcing them into position without any regard to the injury of the tissues in which they stood. This philosophy appeared to me in some respects to be unscientific, as I believed that most if not all of these operations should be founded upon the physiological law to which I have alluded. To illustrate the office of this law in one class of cases will explain my idea of all.

General Consideration of the Effects of different Characters of Force on Teeth.—If a wooden wedge be gently forced between the teeth, there will be for a few minutes a slight sensation of pressure, but no pain, and then this sensation will cease; if the wedge be gently advanced two or three times in twenty-four hours, a separation of the teeth without pain is the result. If a greater degree of force short of causing pain be applied, a greater degree of the sensation of crowding will be experienced, lasting longer, say an hour or two, and if repeated too often or with too great a degree of force, pain will result. On the other hand, if an elastic rubber wedge be used in the same way, beginning with the slight degree of force first mentioned, the sensation of crowding will be experienced much longer, and will subside only after the force of the elasticity ceases; Sometimes this will continue for hours, or even days. The former illustrates the effect of intermittent pressure, the latter of that which is continued.

To give an extreme illustration: Suppose a flat gold ring as thin as paper should be placed around two teeth standing a short distance apart, the band being made to fit closely,

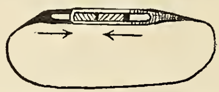


FIG. 56.—Wedge-clamp-band, top view (A).[1]

but capable of being as easily put on as the lid on a well-made box. The presence of something foreign in the mouth would be felt, but no uncomfortable pressure. But instead of such a band, suppose a wedge-band should be made, as in Fig. 56, that could be placed loosely around the teeth and tightened by wedges (as illustrated by Fig. 57), and these wedges should be very carefully forced into the slots, say a thousandth part of an inch once a day, there would be no sensation differing from that caused by the plain closed ring, because the pressure would be too slight to be recognized by the nerves. If this were repeated from day to day, the teeth would gradually approach each other, and in due time would be in contact.

[1] Mechanisms devised by the Author and illustrated in this work are indicated at the end of the inscriptions by the letter A.

Should the degree of force from the wedge be increased daily, the time would come when a slight dragging, but painless, pressure would be experienced for a few minutes, and then it would subside. If, however, the force should be continually increased, the sensation would become unpleasant; and in time would amount to actual pain. This might be carried to a degree of intensity by greater force until the pain would become excruciating. Instead of wedges for tightening the bands, if a screw, connecting the ends of the ribbon by means of nuts, should be used, this

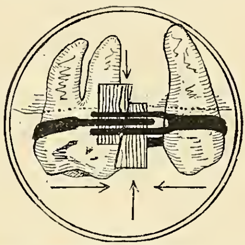


FIG. 57.—Wedge-clamp-band, side view (A).

force would be more easily controlled. If, instead of this band, elastic rubber should be used, there would be a different experience. The pressure would be kept up longer, and as a result the crowding sensation would continue correspondingly, and sooner become painful. To explain why these differences of sensation occur, and how to take advantage of knowledge of the laws which govern them, so as to insure patients against suffering while the regulation of the teeth is in progress, is one of my principal aims.

Irregular teeth are corrected by altering the shape and other conditions of the sockets. The system that this work is designed especially to urge (which will be fully explained as we proceed) largely consists in the observance of physiological principles and the use of kinds of apparatus that will best bring about this alteration so as to cause the highest rate of motion of the teeth with the least pain, by operating upon the socket tissues, within the domain of the physiological functions. I am aware that persons who think that "brute force" embodies the science of regulation of the teeth maintain that physiological acts cannot be sufficiently understood to permit the handling of teeth in this scientific way, but I trust that the reader will be convinced otherwise.

Teeth move by one of two kinds of Tissue Changes in the Alveolus.[1]— The necessary changes in their arrangement are accomplished in two ways: by the reduction of the alveolus through what is called absorption on one side of the tooth, followed by the growth of new supporting tissue on the other; and by bending the alveolar tissue. If the highest art will attain the greatest rate of motion with the least pain, then the importance of a knowledge of that which is necessary to secure this end must be apparent to all.

A few years ago these questions were new, or at least were not generally studied. Everything in the art appeared to be done by guesswork. Teeth were supposed to move from one point to another purely by the application of force, just as would a plummet of iron, if driven by force through soft wood; and so far as the character of force is concerned, it was believed that the manner of its application was unimportant, or at most only a question of the convenience of the operator. It seemed to be regarded as impossible to ac-

[1] With the view of correcting erroneous impressions in the profession concerning my theories upon this subject, caused by misjudgment on the part of some authors and speakers, the substance of these chapters on Basal Principles, which present the same views that I have always entertained and expressed, was made the subject of a lecture delivered by me by request before the anniversary meeting of the 1st District Dental Society of the State of New York, held at Masonic Temple, New York City, January 18, 1888.

complish anything in these operations except through a swamp of pathological difficulties. For several years, as before stated, I have labored to convince my professional brethren that this is an error; that there are laws governing tissue changes, of which advantage can be taken, and that if this advantage were taken, great benefit would result to both operator and patient.

Tissue Changes by the Movement of the Teeth not necessarily Pathological.—That the character of force does govern the question of pain, and that the tissue changes in the sockets requisite for the movement of teeth are not necessarily pathological, as has been supposed, it is my aim to prove. While the pain and exhaustion caused by the changes that are made by art in the position of teeth are clearly indicative of perverted physiological action, the straggling of a tooth from its proper position, or even the drifting of a tooth by improper antagonism with its mate, or from overcrowding by adjacent teeth,—incidents which frequently occur, accompanied with no pain or inflammation,—are equally clear evidences that the tissue-changes have been carried on within the domain of physiological or normal conditions. Several of the following chapters will be devoted to the discussion, in detail, of these principles, supported by the results of experiments, which point out the most important phases of the two characters of force. First will be considered the theory and practice of moving teeth by absorption of the alveolus; second, the theory and practice of performing operations, by taking advantage of alveolar flexibility; third, a demonstration that both processes may be made to harmonize under the same law; fourth, the principles of construction of mechanical devices necessary to attain the highest possibilities under the law.

CHAPTER XI.

ABSORPTION OF TISSUE.—RESORPTIVE CELLS.—DESTRUCTION OF OLD TISSUE AND FORMATION OF NEW.

AS mentioned in the preceding chapter teeth move by two processes, by retrogressive metamorphological action, more or less associated with absorption, and by the flexibility of the alveolar tissues. The term retrogressive metamorphological action is here used in a general sense to express what is sometimes called liquefaction, or a return to the embryonic conditions of the tissues, and the term absorption the carrying away of tissue by the tissues. A full understanding of these physical acts (in all their details) cannot be acquired until the subject is further investigated. One phase of absorption, however, which is worthy of careful consideration, is that explained by W. Xavier Sudduth, M.D., D.D.S.,[1] from whom we quote the following passages, after which other phases will be considered.

"Nature is conservative, retaining only such tissues in the body as are productive of benefit to the animal economy. The process of resorption is constantly going on; cells and tissues, having performed their life-work, are continually being broken down and removed by and through the lymphatic system. It is not to these conditions, however, that attention is directed, but to the removal of the products of inflammation, blood-clots, ligatures, and foreign bodies of every nature that become embedded in the tissues of the

[1] Philadelphia Medical Times.

body. The removal of such substances is dependent upon the action of specialized cells, called resorptive or giant-cells, and the process is physiological.

"The presence of giant-cells is general where tissues are to be resorbed, whether it be in the normal development of bone or in the resorption of the roots of temporary teeth. Here they act as nature's physiological agents in the removal of tissues which have served their life purpose. In fact, all the processes of nature are physiological; her agents—cells—are developed to perform well-known physiological actions, and when a pathological result is produced it has its origin in some outside influence. Cells have not the power to produce pathological results unless stimulated by some agent which lies outside of physiological bounds, and when so stimulated they act through their own peculiar channels."

Office of Resorptive or Giant cells.—"The resorption of tissues through the agency of giant-cells is therefore to be regarded as a purely physiological process. The pathological phase is found, not in the removal of the tissue, but in the irritant which preceded the resorptive process and made it necessary. Thus far, too much stress has been laid upon the visible expression of nature's effort to remove the irritant, and too little on the character of the irritant itself.

"Giant-cells are found in connection with the resorption of bone in normal development, the roots of temporary teeth, and other bodies that nature desires to remove. They are developed in all the above named causes, unless the exuded cells are destroyed and a purulent condition produced. . . .

"The process of digestion is well understood by every student of physiology. The glands of the stomach secrete certain fluids by the action of which food is so changed that it can be taken into the blood and assimilated by different parts of the body. A failure on the part of these glands to produce their normal fluid will cause what we term indigestion. Ordinary food-stuffs, unless prepared and dissolved by the fluid secreted by the glands of which we have been speaking, are not assimilated. We find that what is true of the digestion of food is also true of the digestion of tissue. In order that a tissue may be removed, it must first be digested by the cell fluid, after which it can be taken up by the lymphatic system. . .

"Such are the facts, briefly stated, from which I have drawn the conclusion that the resorption of bone in normal development, of the roots of temporary teeth, of provisional cartilage, of sponges in sponge-grafting, of catgut ligatures, of blood-clots, and of all foreign bodies that are capable of digestion, is a physiological process, and is accomplished by and through the agency of resorptive or giant-cells."

In his valuable work on "Periosteum and Peridental Membrane," Dr. G .V. Black deals with another phase of the question which bears more closely on our subject. He says that when teeth are undergoing changes of position, changes in the attachment in the principal fibres of the peridental membrane occur, which are caused by absorption and rebuilding of bone. In Fig. 58, this author presents the effects of the process.

This figure is drawn from the microscope, the slide being taken from the middle portion of the anterior wall of an incisor socket. The upper portion of the illustration, which is the part nearest to the crown of the tooth, shows the process by which the fibres of the peridental membrane become detached and reattached during movements of the tooth through the alveolus. No very considerable areas of absorption are seen, but groups of osteoclasts appear at very frequent intervals, as shown at *d*, *d*, *d*, which lie in the little bay-like lacunæ of Howship. At all such points the fibres of the peridental membrane appear to be detached. "Indeed," says Dr. Black, "these fibres seem to disappear with the appearance of the osteoclasts, but wherever the bone is not covered by these cells the fibres are found to be in position. At *f* a portion of new bone has been built on to the old, in which the ends of the fibres are secured. In this way, it seems, absorptions and changes in the alveolus may occur slowly, or even with considerable rapidity, and sufficient attachment of the principal fibres of

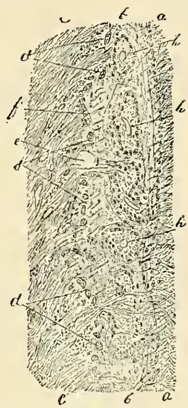


FIG. 58.—Portion of the Alveolar Wall, undergoing absorption (Black). *a,a*, Periosteum; *b,b*, Alveolus; *c,c*, Peridental membrane; *d,d*, Osteoclasts; *e*, Osteoclastic space; *f*, New bone; *h,h*, Haversian canals.

the membrane be maintained to hold the tooth securely while its position is being changed. Parts of the fibres appear to be cut away and some portions of the bone removed, then the fibres re-form and re-build into the wall of the alveolus by a new deposit of bone about their ends." These changes are not confined to young animals or young persons, but may be found in progress in the old, though generally more irregular. "I have not had the opportunity," says this author, "of examining a case in which the artificial movement of the teeth, as in the correction of irregularities, has been made, but from what I have seen I suppose that the absorption and rebuilding occur in precisely the same way. However, in the rapid movements that are often made in these cases, there must be a solid line of absorption along the portion of the alveolus pressed against, thus disturbing and perhaps detaching the fibres *en masse*, while the fibres on the other side are lengthened. In adults, evidences of changes in the alveolar wall may be found

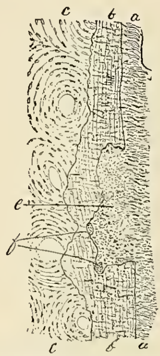


FIG. 59.—Illustrating Process of Absorption of the Alveolar process (Black). *c*,*c*, Alveolar process; *a*,*a*, Peridental membrane; *b*,*b*, Secondary alveolar process; *e*, Recent absorption; *f*, Osteoclasts or absorbing Cells.

about almost any tooth (so far as my observation has extended) that has changed position from the loss of neighboring teeth."[1]

Fig. 59 is another view by the same microscopist, showing the alveolar wall at the posterior surface of a bicuspid that had moved backward slightly from the loss of the crown of the second bicuspid. "The bone, *b*, *b*, shown in this figure and in the previous one, seems to have been built in to restore tissue lost by absorption that in extent was consider-

[1] Page 123.

ably more than the needs of the actual movement of the root. That this absorption has been going on is clearly shown by the Haversian systems of the bone being cut into and portions of their rings removed. This is shown all along the line. At *e* a bay from recent absorption has been made, and, from the presence of two osteoclasts, it is evident that absorption was in actual progress at the time of the death of the individual. Such absorptions, as this latter, are not infrequent in the alveolar walls. They seem to occur without any cause that I have been able to trace; it is probable, however, that they are stimulated by some slight movement of the tooth, and have proceeded beyond the needs, and are again refilled by the deposit of bone."

This microscopist says that "in a large number of examinations very many spaces are found at which there seems to be no attachment of the membrane to the bone, and yet the appearance of residual fibres within the bone shows plainly that the fibres have been previously attached. In these cases there is sometimes evidence of absorption of the surface of the bone, sometimes not, but it seems most probable that the fibres have been removed by this process, though perhaps this may occur from some process not yet noted."

Formation of New Tissue.—In regulating teeth by what we will call absorption—a term which, as before said, for convenience will here be used to cover both of the forementioned changes—the tooth is made to plough its own way through the alveolar process, leaving a gap, so to speak, across which the pericemental fibres stretch, which interstitially fills with embryonic matter. This is gradually organized into that which finally becomes secondary alveolar tissue (Fig. 60). Perfect re-organization of these tissues requires from one month to a year, sometimes longer, depending upon the age and condition of the patient. To reiterate, briefly, so far as the microscope has enabled us to understand this retrogressive and reformative process of alveolar tissue, the pressure of the tooth upon the socket wall excites to liquefaction the bony portion impinged upon, which not only 'melts' these harder portions of the structure, but apparently disorganizes and destroys the fibres extending from the pericementum into it. Whether this destruction of the fibrous connection is real or apparent, however, I think is not proved, for it seems to be a fact that when re-organization of the hard tissues takes place, what appears to be the same fibre, and which becomes invisible by the liquefaction, reappears.

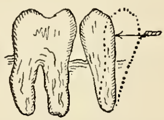


FIG. 60.—Changes in the position of a Tooth in process of Movement by Absorption.

In the case of fracture of a bone when re-union is tardy or difficult, it is well known that an increased irritation of the parts, caused by forcible movement of the contiguous surfaces, will hasten repair. The additional inflammation causes an increased deposit of osteoplastic matter, which accelerates the union of the fractured parts.

The working of this law is well shown in the exostosis of the roots of the teeth of sewing-women, who are constantly biting threads, thus causing calcific growths, by irritation or by slight inflammation.

Fig. 61 represents a specimen in my cabinet of the second left upper bicuspid, showing a large amount of exostosis upon the root.[1] The neck was worn away to a thin flat ribbon by a gold clasp on a partial plate of artificial teeth.

As is well known, physiological changes are healthy func-

[1] Specimen, E. W. B.

tional changes, but it may also be said that pathological changes may be nearly so if not carried so far as to pass into what is denominated organic disease. But changes of tissue necessary to the movement of a tooth by retrogressive metamorphological action, or by what is denominated absorption, are not necessarily pathological. Even inflammation is not always tissue disease; to a certain degree it is a physiological effort on the part of nature to throw off evil, but when it extends beyond what is called a stage of resolution, it may become degenerative. These conditions so

Fig. 61.—Specimen of Exostosis.

merge one into the other that the boundary line can only be arbitrarily given.

Thus, as has been mentioned, in moving a tooth, its pressure upon the alveolar process causes decalcification of portions of the hard tissue and some degree of impairment, if not devitalization, of the contiguous cells which break down, and are probably more or less carried off by the absorbents, which, in turn, are possibly stimulated somewhat by the same irritation that causes the liquefaction; this is also the case when inflammation acts upon them through sympathy from contiguity and continuity. At the same time that this is going on, the advancing tooth, interfering with the blood nutrition, prevents new cells taking the place of the old ones. The tooth moves as rapidly as the tissue gives way. In other words, the tooth advances by "displacement."

It should be borne in mind that the tooth in these operations acts upon the surrounding tissues somewhat like a foreign substance, the influence being similar to that from the use of a catheter in the treatment for stricture, when left in it for a considerable length of time. Aneurism of the aorta, pressing upon the vertebræ, and causing absorption of those bones, illustrates the same point.

On the opposite side of the tooth the reverse of absorption is going on. The tissues are constantly separating, and the gap between the departing tooth and the socket-wall is fill-

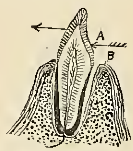


FIG. 62.—Track of a moving Cuspid.

ing with new tissue; the membrane remains attached to the root, and the fibres stretch as the tooth moves along, and is filled in by uew tissue matter. It is natural to infer, as before mentioned, that the irritation caused by the stretching of the pericemental membrane hastens the formation of the interstitial deposit within it. Fig. 62 illustrates a tooth, A, in process of moving through the alveolar tissues, in the direction indicated by an arrow, B, the track of which is simultaneously filled with new tissue.

CHAPTER XII.

DISTANCE THAT TEETH MAY BE MOVED.—RESULTS OF TOO VIOLENT OPERATIONS.—EFFECTS OF PAIN.—LAW OF LABOR AND REST.

IN the art of regulating teeth the operator occasionally finds some stubborn obstacles, among which is the construction of apparatus that will bring about the desired results. It is not always easy to know how to fasten apparatus to slippery conical teeth, and it is not to be wondered at that some dentists are content when they have overcome this mechanical difficulty. But when it is practicable to apply fixtures, teeth may be moved in any direction from one-fourth to one-half of an inch, and in some cases even further. There is no doubt that by care, skill, and sufficient time, a tooth may be moved an inch if the operation is conducted within physiological conditions, which includes the prevention of destruction of the nutrient supplies to the tooth. Generally they are moved laterally; but may be depressed or elevated in their sockets, or even changed from a horizontal to an upright position. With the exception of the "inclined plane," the apparatus formerly used, since this branch of dentistry has been vigorously prosecuted, has been made of elastic materials, metal or rubber, so secured to the teeth by ligatures and metallic ferules as to keep up a constant tension on the tooth to be moved. This traction, after a day or two, starts the tooth from its old home, and it continues to move slowly from day to day, from week to week, so long as the tension is maintained; the apex remaining comparatively stationary as the crown advances. An idea of this change of position may be acquired by reference to Fig. 63, which illustrates by dotted lines the track of a cuspid that has been moved into the place of the first bicuspid, to make room for an instanding lateral.[1]

Results of too violent Operations.—Without considering the possibility of provoking loculosis alveolaris by abusing the socket tissues through improper use of mechanical devices, there are some difficulties to avoid causing, as well

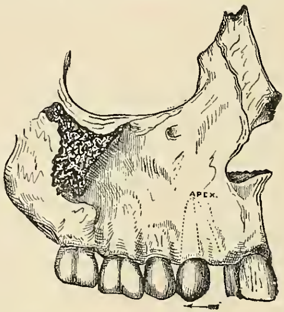


Fig. 63.—Change of Position by tilting Movement of a Cuspid.

as some that are present to be overcome; especially is this true when the roots are perfectly calcified. Sometimes the pulps of the teeth operated upon die from injury at the apex of the roots, either by rupture or by jugulation of the nutrient tracts to them; the latter is brought about by strangulation or through congestion in the adjacent parts. Such improper management may lead to pain, alveolar abscess, discoloration of the tooth, and perhaps elongation of its visible portion, or, possibly, its entire loss, all of which results are generally avoidable.

It is found that the unfavorable consequences occur when

[1] "Cosmos," Jan., '76, p. 16 (A).

the tooth has been rapidly moved a considerable distance, the operation having been attended by much inflammation and pain; while teeth moved but slightly or slowly, having caused little or no pain or inflammation, were not thus affected. Therefore, the difference must arise from the degree or the character of force applied.

It is well known that all animal tissues, especially the softer, when under pressure, are subject to certain physiological or pathological changes. A tight ligature around the finger will arrest the circulation of the blood, which if allowed to remain too long will cause inflammation, and even death of the part, from mortification—a pathological change. On the other hand, a moderately tight ring will, in time, make room for itself, by diminution of the portion of the finger pressed upon, without causing pain, because the pressure is not sufficient to materially arrest the circulation of the blood. While the flesh under the ring is at first compressed, it does not remain so, because nature causes sufficient absorption to free it from pressure. The painless ploughing of a heavy ear-ring through the lobe of the ear is another illustration. These are healthy or physiological changes. Thus we see in one case too severe pressure causes inflammation, leading to pathological or unhealthy changes, while a more moderate pressure causes physiological or healthy changes. From these facts it appears that there is a line beyond which pressure cannot be long sustained without causing inflammatory changes.

As an illustration of this point: the proper bandaging of broken limbs has a stimulating effect in supporting the tissues; while, on the other hand, bandages too tightly applied may cause injury, even to the extent of mortification. In the former case, the action is physiological; in the latter, pathological. Sometimes the power of the absorbents will become impaired or cease altogether, when the tissues are inflamed beyond certain limits. This is well exemplified in some cases of exposed pulps of teeth. If the pulp be highly inflamed, it will not always be destroyed by arsenic; but if previously treated by some other agent for a few days, to reduce the inflammation, the arsenic will be sufficiently absorbed to destroy it.

From these considerations, it will be seen that undue pressure upon the tissues, if allowed to continue too long, will not only cause inflammation, but will also modify or arrest the action of the absorbents, followed by unhealthy changes in the parts involved. On the other hand, tissues

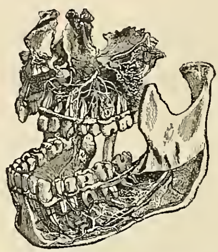


FIG. 64.—Showing the Relation of the Nerves to the Teeth.

can endure a moderate degree of pressure, sufficient to cause absorption, without passing beyond the bounds of healthy action. Therefore, there must be a dividing line within which we may operate painlessly and beyond which we cannot.

Pain.—This brings us to one more point for consideration before we apply our theory to practice; that is, that pain is always to be taken into account in all surgical operations. Pain is a great evil, especially if continuous, and should be prevented, if possible. There must be periods of rest for the nervous system, or it will suffer. A patient can endure great pain, if alternated with periods of rest, while a less degree of suffering, if incessant, will soon cause exhaustion. Though not exactly parallel in some respects, the effect of a continued painful sensation may be illustrated by the case of a patient undergoing the operation of filling a tooth by the aid of a hand mallet. If the taps be very rapid and continuous, the patient becomes nervous and irritable, and writhes in the chair; but if the taps be occasionally intermitted by one or two seconds for rest, the operation can be borne for hours without very much inconvenience. The nerves must have rest; and as the tissues are largely made up of nerves, and their functions depend upon the nerves, it necessarily follows that the tissues must have rest as well. The point just referred to, concerning rapid malleting, I will, however, qualify, though it be a slight digression from the main subject. All the disagreeable impressions that arise from malleting and filing, or from discordant sounds of any kind, act through the nerves of the special sense of hearing; thence oftentimes to and through other nerves, causing various muscular contractions.

We all know that filing or malleting the upper teeth, which have a bony connection with the organ of hearing, is much more disagreeable than the same operation performed upon the teeth of the lower jaw, which lies so inclosed in soft tissues, that the only channel through which the unpleasant impressions are conveyed is the small cushion of articular cartilage between the condyle of the lower jaw and the glenoid cavity of the temporal bone. The illustration above given is here used only as a comparison. Pain, as it is generally termed, is an indication that something is wanted or that something is out of order, information of which is conveyed to the brain through the agency of the nerves of sensation; but pain in its usual sense has not necessarily anything to do with the special nerve of hearing, or with any other nerve of special sense.

I make this comparison, because by it I can more clearly illustrate the effect of what is usually called pain, stopping short of the argument by which we might easily show that all disagreeable sensations, conveyed through or by *any* nerves, are but different kinds of pain.[1]

The brain and its associate system of sensory nerves have a limit in capability to recognize impressions, however distinct, when rapidly made. This capability or power differs in different people, but there is a point peculiar to each and every individual where taps upon teeth in rapid succession cease to be separately recognized.

If we place the plugger of an electric mallet upon a tooth and set the hammer at work, giving blows no more rapidly than in the ordinary use of the hand-mallet, but continuously, the patient can endure it only for a short time. If the rate of speed be increased, without removing the instrument from the tooth, the patient grows more and more nervous, until the increased rate of speed reaches the point where the senses fail to recognize each blow separately. The sensation then grows less disagreeable, becoming more tolerable as the rate is increased from this point; the blows in effect seeming to make one continued sound, growing smoother as the blows become more rapid, exactly as the trembling of the tones noticed in the low bass notes of an organ appears to die away on approaching the smooth and flowing sounds of the treble.

Labor and Rest.—Since fatigue is but a form of pain, it also may be made to illustrate a phase of the subject. This is exemplified in every act of life that comes within the law of labor and rest. If the arm is extended at right angles with the body, it soon tires and falls. Long-continued movement or work is fatiguing; even standing for a long

---

[1] Since writing the above, an ingenious paper entitled "Nature of Pleasure and Pain," by Alfred Fouillée, translated from the *Revue des Deux Mondes,* has been published in Popular Science Monthly, Sept. 1886, p. 671.

time is exhausting, and change of position for the muscles is but another form of rest. Organs, as well as muscles, require periods of rest; the eye tires of seeing, the ear of hearing, so also the sense of taste. Nor is this all, for the involuntary muscles require periods of repose. The lungs, or rather the different muscles that perform the act of respiration, rest between their alternating movements; while one set is causing inhalation, the other set rests; but during exhalation these muscles take their turn at work, and the others become passive; so also does the heart rest between its rhythmic beats, and the intestines rest in the intervals of peristaltic action.

Wherever there is tissue with nutrient circulation, there is tissue which serves to convey nerve force; and where there is nerve energy, there is a substance which is subject to wear and tear. Not only is this true of the muscles, but also of the circulatory apparatus, whether it be for carrying blood or *effete* matter. These are all permeated with different phases of energy, even to the cellular tissue. Wherever tracks of nervous energy lead, there are tissues controlled by them; and where there is work, there will be wear and tear of those tissues, and, therefore, need of periods of rest. Now, as the act of retrogressive metamorphological change is but a phase of tissue labor, it is easy to see that any such labor caused by moving teeth naturally comes under this head, and belongs to this range of phenomena. Hence, in causing absorption, if the degree of force applied be kept within the limit of physiological law, the tissue changes will be less painful than if the law is violated; and if, in addition, the labor is intermitted with proper periods of rest, the tissue changes will be more apt to be free from pain than if the force be continuous. It is true that a tooth of the second set which has erupted to one side of a deciduous tooth naturally moves continuously toward its proper place if it moves at all, after the deciduous tooth that caused its misplacement is extracted, and that the tissue changes are physiological, but this action cannot strictly be regarded of the same kind as that caused by force derived from mechanical apparatus, because the force that causes the movement of the tooth in the former case is derived from the elasticity of the alveolar tissues acting exactly in the same way that these tissues do when they cause a tooth to retrace its steps after having been moved from an abnormal position to its proper place; in other words, the tooth is not only moved by an inherent tendency to fall into line, but by an effort upon the part of the alveolar tissues that have been cramped (by the overpowering force of the tooth, in the process of eruption), to liberate itself from its cramped condition; on the other hand a tooth that is moved by mechanical force moves by being made to cramp or to spring the alveolar tissues before it.

To return to the main subject, we see from these premises or considerations that the differences in operations which bring about healthy or physiological changes by pressure, depend on the character of force applied, including degree and length of time; that the question of pain depends upon controlling the force, applying it lightly if continuously, or periodically if greater; the latter allows the tissues to act, and then grants them a period of rest. But pressure once properly made should never be reduced, except through tissue-change. To illustrate this, I will now give a few of my experiments upon teeth, which will show in the main what I regard as the principles of all such operations. I cite only a few, but similar experiments have been repeated by me in a number of cases, all of which show very nearly the same results.

CHAPTER XIII.

MOVEMENT OF TEETH BY ABSORPTION OF THE ALVEOLUS. EXPERIMENTAL INVESTIGATIONS.—THE DIVIDING LINE BETWEEN PHYSIOLOGICAL AND PATHOLOGICAL CHANGES, AS INDICATED BY PAIN IN TISSUES UNDERGOING ABSORPTION BY PRESSURE.—THE LAW.

TO illustrate the effect of different characters of force and different degrees of pressure upon tissues, let us take an experimental case; a young lady aged fourteen years, of nervous-sanguine temperament, healthy but not robust, and living rather an indoor life. The eight front teeth in her upper jaw were very irregular, so much so as to prevent proper antagonism, as well as distinct enunciation.

It was thought best in this case to extract the left first bicuspid as a preliminary step, and force the cuspid back into its place to make room for the four incisors and left cuspid. After extracting the bicuspid, a gap of three-eighths of an inch was left between the cuspid and the second bicuspid. For two weeks the most improved elastic rubber apparatus was applied to move the cuspid, giving rise to pain, inflammation of the sockets, and nervous exhaustion. Although these strong elastics were used, yet up to this time they had not perceptibly moved the tooth, which fact was supposed to be due to the great length of the root of the cuspid, and the firmness of the socket. The apparatus was then removed, and the parts were allowed a few days of rest.

After the inflammation had subsided, a different apparatus was applied with more success.[1] A very thin metallic band-strap was made to extend around the cuspid and first molar, the ends of the strap being connected on the buccal surface by means of a screw passing through nuts, as shown in Fig. 65.[2] This screw had sixty threads to the inch,[3] and was shaped at the anterior extremity to fit a watch-key

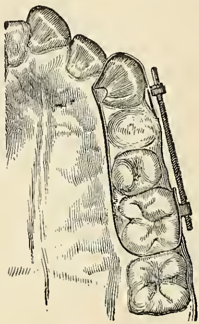


Fig. 65.—Drawn from the original Cast in the Author's Cabinet (A).

(Fig. 66). This simple apparatus (which I denominate a clamp-band) having been applied, the screw was turned so as to cause a slight sense of tightness or pressure, but not enough to cause pain. This sense of tightness passed away within an hour, leaving no unpleasant feeling whatever. Even the instrument caused little or no inconvenience. The screw was turned one-half of a revolution morning

[1] Several devices were used in an experimental way upon this case, which acted in various directions upon the different teeth; but to simplify the argument, only the portion best calculated to explain the subject is mentioned.

[2] Published in "Dental Cosmos," January, 1876.

[3] Although sixty threads to the inch as here given is true of the screws used in this experiment, it should not be inferred therefrom that I use no other number of threads per inch. I use screws varying from sixty to one hundred and forty threads per inch.

and evening, thus advancing it one-half of a thread, or $\frac{1}{120}$ of an inch by each operation, or $\frac{2}{120}$ of an inch per day.

It must be remembered that the band had but one screw; consequently, when it was advanced $\frac{1}{120}$ of an inch, the tooth moved only half that distance, or $\frac{1}{240}$ of an inch, at each operation, and, as this act was repeated twice every day, the tooth moved $\frac{2}{240}$ or $\frac{1}{120}$ of an inch per day.

This rate of movement was found to cause no pain; a repetition of the sense of tightness was noticed for about an hour after every advance of the screw, but it was easily borne by the patient, and caused no perceptible inflammation. The cuspid continued to advance at this rate ($\frac{2}{240}$ of an inch) daily, still causing no pain. It may be well to

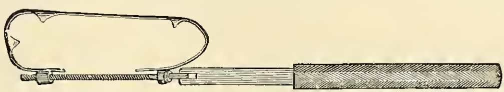


FIG. 66 represents the Band and Screw with a Key applied.

note here that no visible change took place in the position of the two posterior teeth, around which the clasp was fastened, because the three roots of the molar and the broad, flat root of the second bicuspid acted as sufficiently firm anchors. This degree of firmness of the anchor teeth is not, however, to be found in all cases.[1] This slow advance of the tooth, $\frac{2}{240}$ of an inch per day, acted so admirably that it was thought best to increase the rate of progress, with a view to hurrying the operation, if possible. Accordingly, the screw was turned an entire revolution each morning and evening. This advanced the screw $\frac{4}{120}$ of an inch per day, and the tooth half that distance, $\frac{2}{120}$ or $\frac{4}{240}$ of an inch. This caused some pain, which lasted about three hours, gradually passing away.

It now became evident that this rate was too rapid; but,

[1] See Chapter on Anchorage Resistance of the Socket Tissues, p. 465.

to make the experiment still more satisfactory in a scientific point of view, the screw was advanced another half thread each morning and evening, amounting to three revolutions daily. The pain now became almost continuous, accompanied by considerable inflammation. The patient was irritable, and showed signs of nervous exhaustion; but the pain, after eight or nine hours, gradually diminished. The screw-band lessened in pressure as the tissue gave way; differing in this respect from the rubber apparatus, which maintained a constant force. This satisfied me that the views I had entertained as to the limited value of elastic rubber for moving teeth, were correct. It also proved that a certain degree of pressure applied periodically would be followed by no pain or other unhappy results. I will here say that, however correct my reasoning may be, and whatever the facts are about these laws of the tissues, I do not by any means advocate dispensing wholly with the use of elastic materials, for there are some cases in which we cannot apply intermittent force in a manner to accomplish the desired end; in fact it is not always necessary, especially with young children, for reasons which will be explained later. Furthermore, I do not assert that absorption cannot be carried on within the domain of physiological functions by the application of continued force *if* it can be kept under control. The question is not what can occasionally be done, but what is the best and most scientific way to do it.

Dividing Line.—Having proved by this experiment that the degree of force which I had applied in the case was too great, I reduced it considerably, and then gradually increased it until I gained the highest degree short of causing pain; which, as soon as the inflammation had subsided, proved to be the same as before, namely $\frac{1}{240}$ of an inch at each operation, making $\frac{2}{240}$ or $\frac{1}{120}$ of an inch daily. The remaining teeth were brought into line by the use of hooks, loops and bars attached to screws; but, as at that time I had not succeeded in making a sufficiently firm attachment for apparatus acting intermittently, the turning of some of the teeth was effected partly by the use of elastic rubber.

The question now arises —Can a general rule of treatment be established that will insure the avoidance of pain? It may be thought that tissue-changes are erratic and unreliable, consequently that they cannot be brought within the compass of mathematical law, however broad; but my experience teaches me that so close an approximation to accuracy can be arrived at as to be of great value in the science and art of regulating teeth.

The time required to complete the case above-mentioned was about five months. Some cases will admit of even more rapid advancement than $\frac{2}{240}$ of an inch per day. A variation from this standard, by the addition of $\frac{1}{240}$ of an inch per day, I think will be found to suit any case, say, from about fourteen to twenty-five years of age. By these figures it will be seen that at this age or later, forty to sixty days will be a sufficient time to move a tooth, painlessly, through solid alveolar tissue one-fourth of an inch by absorption. Through open sockets the rate can be greater.

In practice, patients may trust to their sensations to decide the proper rate of progress; in fact, they should know this rate better than the operator. My custom is to advance the tooth until the pressure causes a slight uneasiness, resembling that occasioned by a particle of food between the teeth. This point lies between a daily advance of $\frac{2}{240}$ and $\frac{3}{240}$ of an inch—that is to say, the screw, with sixty threads to the inch, may be turned from one-half to three-fourths of a revolution each morning and evening. The best time for this is about nine in the forenoon and six in the afternoon. This gives sufficient time for the tissues to act and to rest between the operations, and interferes

11*

less with comfort in eating and sleeping. The patient, being in no pain, can be as cheerful and calm as if no operation were in progress; and in a short time may be taught to turn the screw or key, thus avoiding half the otherwise necessary visits to the office.

If, by some accident, the apparatus slips off, it should be immediately replaced, as teeth in process of movement will rapidly retrace their steps, requiring some time to regain their lost position on account of the undue congestion and inflammation which soon sets in. This caution is necessary, also, in exchanging one apparatus for another. No time should be lost; the new one should be ready before the old one is removed.

While the figures I have given show the approximate rate of the lateral movement of the teeth through the hard tissues by absorption, they do not show the rate of absorption of the soft tissues. All animal tissues, except perhaps the nails, hair, and the enamel of the teeth, are appreciably affected by pressure, and all are governed by the same laws, but the rate of absorption varies somewhat in different tissues, each having its own rate.

There is another plan of regulating teeth which, in the character of force, ranks between the screw and the elastic rubber. This causes an intermittent pressure, but does not maintain the ground it has gained as well as the screw. I refer to the well-known Inclined Plane,—a device sometimes made of metal or ivory, but more generally of hard rubber, so shaped as to fit tightly over the teeth of one jaw, and to form an inclined plane for the irregular teeth of the other to bite upon, the inclined surface giving them a tendency to slip in the direction desired.

This simple method is particularly applicable to children whose teeth are only partially developed. Although the force is not applied with as much accuracy as by the screw, yet, as the incomplete portions of the roots are to some extent elastic, the crowns will move easily. Again, the inclined plane may be used when the teeth are short and conical, where it is difficult to apply other apparatus. The patient presses upon the irregular teeth every time the jaws are firmly closed; and this pressure, although only momentarily applied, is so often repeated that the result is generally satisfactory. By use of the plane the liability to inflammation is avoided, since the patient, upon biting too forcibly, experiences pain, and consequently refrains as much as possible from so doing.

The inclined plane may sometimes be used to move fully-developed teeth; but the movement is so slow that it often fails to effect the desired result, because the patient becoming discouraged, is unwilling to persevere long enough in its use.

If the results of these experiments (and they are supported very closely by other and similar experiments made on cases at the adolescent age and beyond it) are to be relied upon as approximately showing the facts, it seems legitimate to deduce the following conclusions: 1st. That in regulating teeth, the force should not exceed the bounds of physiological functions. 2d. That the plan of moving teeth by elastic materials, though practical if kept under perfect control, is so difficult to manage that it often leads to pain and inflammation, and is sometimes dangerous to the future usefulness of the teeth, while a properly constructed apparatus, intelligently operated by means of screws, insures beneficial results, without pain or nervous exhaustion. 3d. That if teeth are moved by absorption through the alveolar process about $\frac{1}{240}$ of an inch every morning, and the same distance in the evening, no pain or nervous exhaustion follows. 4th. That while these tissues will allow an advance of a single tooth at this rate ($\frac{1}{240}$ of an inch) twice in twenty-four hours, without exceeding physiological functions, if a much greater pressure be made, the changes will become pathological.

We may briefly state the substance of the above paragraphs, by saying that soft osseous as well as fleshy tissues may be painlessly made to undergo the process of absorption physiologically, through retrogressive metamorphosis, without any doubt, by a proper degree of force intermittently applied, and maintained during certain intervals of rest; and in the movements of teeth through the alveolar process, the dividing line between physiological and pathological change may be said to lie between $\frac{1}{240}$ and $\frac{1}{160}$ of an inch, which may be safely repeated once in twelve hours.[1]

While these experiments show the approximate rate of painless movement of a tooth through the alveolus, they are not intended to cover the question of the rate by the flexibility of the alveolus, or if drawn partially from the socket, as in efforts at so-called "elongation" of the teeth. Nor am I able to state exactly what should be the rate of the latter operation, owing to the difficulty of securing a full record, on account of the slipping of the apparatus, or want of intelligence on the part of the patient. So far, however, as I can judge from records obtained, the rate is somewhat greater than those already given, varying up to as high as twice the rates above named. I refer those of my readers who are interested in this question, to the B— case, Part XVII., on Elevating Teeth, the statistics of which were by request carefully preserved by a very intelligent patient, for whom I drew an upper cuspid from a point far up in the alveolus. As this operation involved the absorption of some hard tissue, it cannot be regarded as giving the definite rates at which a tooth would move longitudinally with the socket. The

[1] Calculations:—$\frac{1}{240}$ (half day) $\times 2 = \frac{2}{240}$ (whole day) $+ \frac{1}{240}$ added to meet all cases $= \frac{3}{240} = \frac{1}{80}$ per day, or for every 12 hours $\frac{1}{2}$ of $\frac{1}{80} = \frac{1}{160}$ of an inch.

table given in that case shows a rate varying from $\frac{1}{160}$ to $\frac{2}{160}$ of an inch every twelve hours.

Fig. 67, copied from the accounts of the case described

FIG. 67.—B, Metallic band tied with string used first; A, Clamp-band and long-band associated with other apparatus; C, Metallic band secured with clamp-band strings and a T; D, Clamp-band; E, Rubber ring cut from tubing, shown in extended condition; S, Separate device to force apart the right central and cuspid to make room for the lateral; F, Lug to fit the long band; P, Rubber tubing; T, Screw T-piece to hold the band in place, also used to draw instanding teeth outwardly; R, P, Portion of rubber retaining plate; J, Screw devices used on retaining plate to force the bicuspids outward.

in pp. 161–165, illustrates independently most of the apparatus used in the experiments.

It might be thought that the influence of the screw is of little or no value a few minutes after it is applied to the teeth. Such a view would be erroneous. In fact, the greatest value of the screw does not lie so much in the degree of force it causes at first as in its placing the tissues in a condition most advantageous for undergoing retrogressive changes. For further explanation see page 189.

CHAPTER XIV.

MOVEMENT OF TEETH BY FLEXIBILITY OF THE ALVEOLAR TISSUES.

IN childhood the teeth are moved easily by art, and the rate of absorption of old tissue and formation of new is nearly equal; but in proportion to the increase of age the teeth move more slowly, and the reproduction of supporting tissue is still more tardy. If the alveolar portion of a jawbone should be composed entirely of cartilage, it would easily bend, but as it is more or less calcified, bending becomes more difficult, in proportion to the degree of calcification, which increases with increasing age. Although this illustration is extreme, it is so self-evident that it will serve to explain the difference between the conditions of the alveolar ridge in childhood and those of adult age, and to show that in proportion to the degree of flexibility of the tissues, teeth can be moved in some directions more rapidly than by absorption.

The possibilities of regulating teeth a few years ago were erroneously attributed mainly to the "vascularity" of the bone. Teeth move by retrogressive metamorphosis, and by the flexibility of the alveolar tissues. The main cause of this flexible quality of the alveolus is not the number of blood vessels,—for it is no more highly endowed with them than are other bones,—but to the cartilaginous character of a large portion of this tissue, which is more marked in childhood, becoming less so as age increases, but never entirely ceasing.

Besides the cartilaginous character of this tissue, it is diploic in structure. This is illustrated by Fig. 68, taken from Dr. Black's work, which shows a half section of a cuspid and a portion of the alveolar tissue of a man forty years old, the specimen being cut close to the gingival border, so as to show the rim of the socket wall. The membrane was very thin and firm, and a large piece of the anterior wall of the alveolus adhered to the tooth when extracted. It will be observed that most of the blood-vessels of the peridental membrane lie in depressions in the bony wall of the socket.

At birth there is but a slight degree of calcification of any of the bones; a provision of nature which prevents the

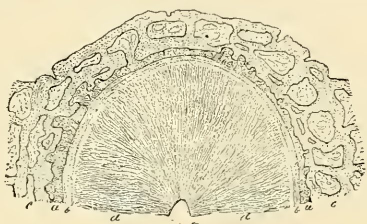


FIG. 68.—Section of half a root and its socket. (Black.) *a*, Peridental membrane; *b*, Cementum; *c*, Alveolar process; *d*, Dentine; middle, pulp canal.

injuries that would almost daily befall a child at that age before it has attained a sufficient degree of experimental knowledge to protect itself. As intelligence, increasing by experience, throws a safeguard around the child by teaching caution, and the necessities of life impose duties that require physical strength, the bones are rendered more and more firm by exercise and calcific deposit, though never to such a degree of hardness as to lose all their flexibility; and as the relation of different parts of the physical economy is a unit, the changes in the alveolus very nearly correspond.

While the thinness of the buccal and labial wall of the upper sockets admits of the rapid movement of teeth outward, on account of this flexibility, the greater thickness of the lingual wall renders the flexible character of the bone of little or no advantage. On the inner side, therefore, the

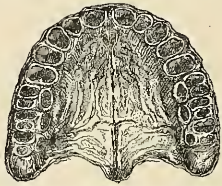


FIG. 69.—Upper Jawbone, showing the Dental Sockets. (⅔ diameter.)

movement of the teeth must mainly depend upon absorption.

In some portions of the lower jaw we find quite different conditions; while the walls of the sockets of six or eight of the anterior teeth are thin, and also the lingual walls of the

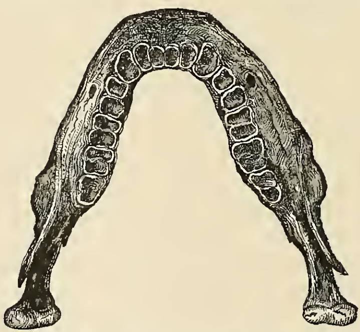


FIG. 70.—Lower Jawbone showing the Dental Sockets. (⅔ diameter.)

entire arch, (thus rendering the movement of the teeth in these directions easy and rapid,) the outer walls of the molars and sometimes the second bicuspid sockets are so thick, that the outward movement of these side teeth is slow, because mainly dependent upon its absorption.

Although the inward movement of all the upper teeth, and the outer movement of the lower side teeth, or a movement nearly horizontal with the alveolar ridge, is accomplished mainly if not wholly by absorption, the outward movement of the upper, or inward movement of the lower teeth by absorption, alone, would not always be for the best interests of the case ; not as judicious as to take advantage of the flexibility of the alveolus ; because, to say nothing of the fact that the buccal and labial walls of the sockets may be weakened by absorption, it is a slower and more tedious process than is necessary.

But when the rate of movement of teeth exceeds the alveolar flexibility, the strain will cause such injury to the tissues as will generally lead to pain. Therefore to insure immunity from pain it is necessary to confine the rate of movement within the limits of the normal degree of flexibility. This statement, in connection with what has been said concerning pain caused by overstepping the domain of physiological functions in moving teeth by absorption, may appear contradictory, but in reality it is not so. Although to insure against pain in moving teeth by absorption, the rate of motion cannot much exceed certain limits, as shown in the preceding chapter, it is possible to attain a more rapid rate when the case will permit of the bending of the alveolar tissues; especially is this so if the ridge can be bent bodily. This "*if*" refers to the possibility of opening the mesial suture between the halves of the upper maxillary bones, in the operation for widening the arch. This question will be fully dealt with in the Chapter. XVI.

The theory of moving teeth by the bending of the process bodily is to avoid absorption by using sufficient pressure to bend the tissue before absorption has time to take place. But, in practice, this theory cannot strictly be carried out ; because the bending of the alveolus is accomplished by the pressure of the teeth upon the socket walls, and therefore causes more or less tissue excitement, which leads to retrogressive change. The philosophy of this operation in such cases, mechanically considered, consists mainly in distributing the force along the line of teeth, so that while it will do the work desired, the degree of force will not be sufficiently great at any one point in the line to pervert the functions of the socket tissues by the strain incident to the bending process. While the sum total of the force necessary to bend nearly the entire ridge on either side of the arch would not cause pain, the result might be quite the contrary if a sufficient degree should be applied to move only a section of it. In fact, it may be said that, other things being equal, the danger of perverting the functions of the tissues in these outward movements by bending, is in a measure in inverse ratio to the number of teeth acted upon. In this movement, the question naturally arises,—What are the differences between the conditions of sockets where the teeth have been moved by absorption alone, and where too much force has been applied to only one tooth with the view of bending it? and also, How do these two conditions differ from those brought about by moving a row of sockets at the same time by the bending process? The consideration of these questions is the object of the next chapter.

CHAPTER XV.

ABSORPTION VS. FLEXIBILITY OF THE ALVEOLUS.

WHEN a single upper tooth is moved outward by absorption it ploughs its own path through the cancellated portion of the alveolus to the external plate; but once there, instead of its moving further by absorption, the plate becoming decalcified by the irritation, so that its flexibility is increased, the tooth generally moves by the yielding of the plate before it, and if the onward movement be persisted in long enough, the shape of the roots may be felt under the tissues by the finger. All these conditions may exist, too, without materially altering the original position of the adjacent teeth and the alveolar tissues about them. Although the outer wall of the socket is bent, the inner wall for a time is often slower in its movement; sometimes it seemingly remains comparatively stationary.[1] In a short time, however, both walls are found to have undergone changes of position and form—the inner having moved up to the teeth, the outer slightly thickening; the latter being a phase of action upon the part of alveolar tissue that is now recognized as induced by the presence of teeth. This is shown where the plane and shape of the necks of the sockets around the irregular teeth correspond with their position; see Fig. 48, Part III.

Fig. 71 illustrates a section view of an upper jaw and opposite bicuspids and their supporting tissue, showing the form of the sockets before and after an operation by absorp-

[1] For reasons of this see page 189.

tion; C, C, the original position of the teeth; T, T, the position after the operation; B, B, and dotted line in tooth, original position of ridge; P, P, and I, I, the same after completion of the operation; D, D, the final surface line of the inner wall; and F, F, the surface line of the outer wall several months subsequently.

When several teeth, such as the upper bicuspids and molars, are together moved rapidly outward by force made to bear equally along the line, the crown and neck portions of the roots of the teeth and their sockets all move together by the bending of the ridge, in a manner not altogether unlike that in which a row of corn bends when acted upon by the

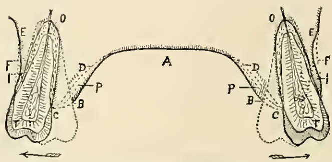


FIG. 71.—Section view of Upper Jaw cut at the Bicuspids to show the ultimate changes in the Alveolar Ridge from widening of the Dental Arch by Absorption.

wind ; but while this portion moves, the apices of the teeth and base of the ridge remain comparatively stationary, possibly the former moving slightly in the opposite direction through the alveolus, because the fulcrum of the teeth is at a short distance from the apex of the roots.[1] Although the rate of movements by absorption can be, and has been, approximately ascertained, the flexibility of alveolar tissue varies so much at different ages, that the latitude is not only considerably greater, but more difficult to tabulate. The confounding of this fact with the rates by absorption is the point on which some adverse critics have made mistakes.

If at the time of beginning a rapid widening of the upper arch by jacks, a plate be made so as to closely fit

[1] See "Lateral Movements of Roots," Vol. 2; also "Cosmos," 1882, Vol. XXIV, p. 190. (A.)

the roof of the mouth, the gums and the lingual walls of the teeth, it will be found after a few days that the action of the jacks has caused a separation between the outer portion of the plate and the gums, sufficient to cause the plate to rock on the middle portion of the roof of the mouth, and that if this plate be removed and substituted by a new one made to fit, the movement of the teeth being continued, a similar change will take place between this plate and the gums; this proves that the ridge has been bent outward.

Fig. 72, illustrating another case in practice, will serve to explain more fully these changes in the position of the alveolar ridge and the comparatively stationary relation of the

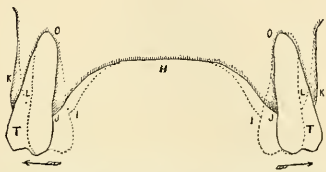


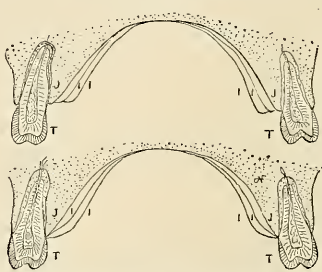
FIG. 72.—Section view of the Upper Jaw, showing the immediate changes in the position of the Teeth and shape of the Alveolar Ridge caused by the widening of the Dental Arch by Flexibility.

teeth; J, J, dotted line, the original position of the teeth; I, I, the original lingual wall, and L, L, the external wall of the socket; T, T, the position of the teeth after the operation, and the shaded portion K, that of the socket.

Figs. 73 and 74 illustrate in section similar cases, showing by the plain lines the different positions of the lingual surface of the alveolar ridge, as obtained by careful experiments with different plates made to fit at successive stages of the process; I, I, and J, J, illustrate the contour of the ridges, before and after the operations, showing also the relatively stationary position of the teeth to the ridges at completion of the operation.

As an illustration of the value of the operation for bending the ridge, take a case of an upper jaw so much smaller than the lower that the arc of the external plate of the upper ridge is less than that of the internal plate of the lower. In such a case, the widening of the upper arch sufficiently to make the teeth antagonize properly with the lower, would, if secured purely by absorption, cause great waste of socket tissue, and leave the outer walls very thin if not completely ploughed through.

To avoid this waste, in some degree, the two arches may be moved in opposite directions sufficiently to be brought to-



FIGS. 73 and 74.—Showing the Change in the Position of the Alveolar Ridge caused by widening of the Dental Arch by Flexibility.

gether midway, but by the bending process the upper teeth collectively may be forced at a sufficiently rapid rate to carry the sockets or alveolar ridge along with them, until proper antagonism with the lower teeth is secured, without altering the original position of the latter.

If the degree of force is not carried beyond the proper limit, which is generally best determined by the sensations of the patient, this latter plan will not cause any suffering.

While the rapid movement of only one tooth may give pain because of too severe strain, the rapid movement of several teeth, as before said, is not so liable to injure the socket tissues, for the reason that the degree of force that is requisite to move an entire line, although considerably greater than that which is usually necessary to move one tooth, is so evenly distributed along the line that no tooth will be acted on by a force sufficient to cause much retrogressive change of the tissues.

If the greater number of teeth be already in proper position, little would be gained by trying to bend rapidly the sockets of one or two intervening irregular teeth, although it is sometimes possible to do so without starting the adjacent sockets and teeth. Even should it carry out to line a small irregular section of the ridge, the attempt to bend

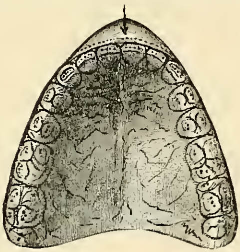


Fig. 75.

such a limited section rapidly would be unwise, and the operation would perhaps end in failure, on account of the pain it would cause. This would not be the case if the plan by absorption alone were adopted; even if it only partially enter into the process of the operation it would probably be a painless success. provided that the rate of motion should not exceed the physiological functions. In fact this combination of the two processes will be found to be the best plan in many cases, for it would, by the slight decalcification of the tissue, permit a rate that would exceed that of the normal flexibility of the alveolus, but the rate of motion of the teeth should not exceed the degree of the normal flexibility of the alveolus, added to that derived from its decalcification, brought about by the excitement from pressure of the tooth against it.

The question now remains as to what takes place in the portion of the alveolar ridge anterior to front upper teeth, in cases of protrusion of the same after they are forced backward, as relatively illustrated (ideally) in Fig. 75, which shows the original shape of the anterior portion of a V-shaped ridge in contrast with the subsequent esthetic arrangement of the teeth. As before said, the correction of protruding teeth is accomplished mainly by absorption of the alveolus posterior to the teeth moved, and does not depend much on flexibility of the ridge; but, while this is a fact, it is equally true that the portion of the ridge lying anterior to the incisor teeth does not remain in its original degree of prominence, but follows on. Like the lingual wall of the sockets of the side teeth, in the widening of the arch, as before explained (Fig. 71), it follows after as if drawn by the affinity of the teeth. This following of the socket tissues is not always as rapid as the advance of the teeth, but it is sufficiently so to prevent any visible separation taking place between the tooth and socket. While this change of position of the socket-wall is generally completed within a few weeks after the operation, I have known cases where the ultimate change of contour of the labial portion of the ridge required a year.

Thus, it will be seen, this ridge of semi-provisional bone, consisting of a soft cancellated structure covered with a shell of denser tissue perforated with a row of conical wells extending from summit to base, offers to the dentist conditions that enable him to meet more easily the mechanical difficulties of regulating teeth, and to accomplish greater esthetic changes than would be possible if these bones were as hard as most other bones of the system. In fact when we consider that the force applied to the necks of the teeth causes them to act as levers upon the sockets, with one end fixed in the thickest portion of the base, where stability is most needed, and at the same time where the force applied acts least, while at the neck portion, which needs to be moved, the force is most powerful, and acts upon the weakest and smallest quantity of alveolar tissue, it is difficult to conceive how the conditions could be more favorable for moving teeth.

CHAPTER XVI.

SEPARATION OF MAXILLARY BONES.—OPERATIONS BY ABSORPTION OR BY FLEXIBILITY MAY BE CONDUCTED PAINLESSLY UNDER THE SAME LAW.—HIGHEST RATE OF MOTION PROPER.—REVIEW AND CONCLUSION.

WE do not know from actual observation exactly what takes place in the alveolar tissue while it is being bent, but enough is known of this tissue under similar circumstances to enable us through analogy to conjecture with some degree of accuracy, for it is natural to infer that a strain must excite the tissues in a manner somewhat similar to that in which the pressure of the teeth against the socket walls acts, and if so, must contribute to their flexibility. Thus we may see that although teeth can be moved more rapidly by taking advantage of the flexible quality of the alveolus, whether in its normal condition or when partially decalcified, than by its absorption alone, both may be carried on within the domain of the physiological laws, if the operation be properly conducted.

The question now naturally arises: Will decalcification and absorption of the socket tissues take place from the strain continuing after completion of the operation? Undoubtedly they will to some extent, but the amount at most must be slight, and depends upon the degree of reactive tendency of the tissues. This is supported by the fact that when an arch has been widened by instruments, and these are not removed, the devices in a few days will relax in their rigidity upon the teeth and become loose. Perhaps, this may be more clearly understood by recognizing that absorption, when teeth have been moved by bending the ridge, has two phases, local and general—local at points where the tendency of the ridge to return to its original position *causes* impingement against the teeth, and general whenever there is a strain down deep in the tissues on the one side and a cramping on the other side of the ridge *caused* by the bending process. (See note, p. 189.)

As this ridge after the operations for widening of the dental arch is stayed by a line of teeth, held in place by the retaining mechanism, the pressure will be so divided among the different ones that but little absorption can take place in the outer wall. Even if it exists at all, experience shows, as before mentioned, that the greater portion of the strain diminishes rapidly after the teeth are moved, consequently absorption does not long continue, and, having ceased, the tendency is to a reversal of the process, resulting in a slight thickening of the outer wall. That there continues in the tissue after this time a slight tendency to return to its former position, every dentist knows to be true, but this tendency does not appear to be sufficient to cause liquefaction of the tissue, or it would not be essential to use a retainer for so long a period to destroy this reactive tendency—a time extending over months and possibly years, depending upon various circumstances, such as the age of the patient and the cause of deformity.

Notwithstanding all that has been said, it should be remembered that in all cases, even where rapid movement seems best, caution should be exercised as to the degree of force applied, for while the application of insufficient force subjects the patient to loss of time, the use of too great a degree of force may not only cause pain, but in operations for widening the arch may result in the separation of the two halves of the maxillary bones, which would not only render the completion of the operation more difficult, but might, unless the parts are brought together again (either by nature or art), create a deformity by causing a space between the central incisor teeth. The possibility of this accident is due not only to weakness in the kind of interlocking of the opposite corrugations in the borders of the bones, but to the limited area of such corrugated surfaces due to the thinness of the portion of the bones lying be-

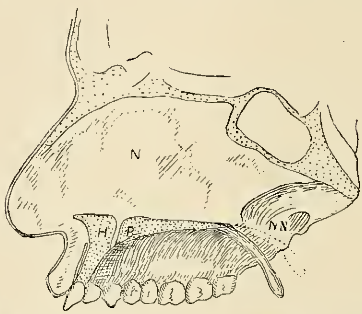


FIG. 76.—Section view of the Upper Jaw cut at the Median Line, to show the natural weakness of the Sutural Connection consequent upon thinness of the Bones. H P, Hard Palate and Suture Boundary; N, Nasal Septum; P N, Posterior Nares.

tween the nasal and the oral cavities. Some idea of this anatomical weakness may be obtained from examination of Fig. 76, which illustrates a section view of the right half of the upper jaw and nares cut along the median line. To be sure, such accidents are comparatively infrequent; still, their occasional occurrence being a fact, it is important to operate cautiously. If, however, separation of these bones takes place there need be no alarm, as no permanent injury will result if the case is in competent hands; sometimes in cases of crowded front teeth a slight opening will aid in making room for them. Separation of the maxillary bones may be avoided by binding the two halves of the jaw together by a fixture placed across the arch, and attaching it to one or two opposite teeth, and then moving the teeth in detail. A bow-jack or a clamp-band or even a wire or string is sufficient. To draw together bones that have separated, or as a precautionary measure against their separation, one of my methods is, to place on each lateral incisor a gold ferule having a platinum wire staple soldered to the labial or lingual surfaces, and connect these ferules by a wire or string, substantially as shown in Fig. 77. The banding and tying of the cuspids is often a better plan, but for further consideration of the means of

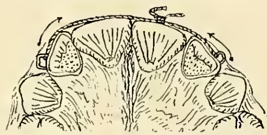


FIG. 77. Binding the halves of the Upper Maxilla (A).[1]

controlling cases after these bones have separated. (See Figs. 213–215, p. 291; also Widening of the Dental Arch, Vol. 2.)

Operations by Absorption or by Flexibility may be conducted painlessly under the same Law.—Although it is now many years since the experiments that led to the above conclusions were made, I have not yet found any reason for materially changing these conclusions; but while the rates of motion mentioned are apparently sustained by extensive experience it is not my intention to convey the idea that a mathematical calculation should be attempted at each operation; but when satisfied that the statements are true, they may be acted upon as basal principles. As before said, the degree of pressure should be governed mainly, if not entirely, by the sensations of the patient. Granting that future experience may possibly show that in the ever-

[1] "Independent Practitioner," 1886.

varying conditions of tissues, there may arise a sufficient number of exceptions to make an average slightly different from that shown by the statistics here given, it would neither weaken the theory, nor reduce the value of the lessons derived from these investigations, namely, the reason why devices hurt, and how pain can be prevented and the reason why patients know best how far to carry the increase of force so as to be nearest to the point of pain and yet not overstep the line and cause pain—in short, its humane value.

Following out the argument (but endeavoring to present the subject so as to prevent error of judgment often shown by critics in confounding the law of physiological functions of the tissues with the principle upon which the mechanical apparatus must be constructed so that its operations shall be in harmony with the law, making both subservient to the same end), it will be evident that, while the screw is not absolutely necessary, it is the most effective instrument in the great majority of cases. Among several reasons, one why intermittent pressure seems to be more scientific than the continuous, is that by it the highest rate of progress which is possible to attain, painlessly, can be accomplished. Continued pressure, however, although it draws upon the energies of the tissues, and is always accompanied by a consciousness of something crowding, is, if kept considerably within the boundaries of physiological functions, often comparatively painless; and, if it can be confined within this measure of pressure, the results in many cases will be satisfactory. Especially is this true, as already stated, of children under twelve years of age, in whom the alveolar tissues are very soft, and the roots of the teeth are only partially developed; in whom, also, the physiological functions are active, and the recuperative power rapid, the same degree of injury to these tissues usually being less painful to them than it would be in adult life, when the tissues are more fully developed. But at a later age, and at the time when most operations for correcting irregular teeth are called for, intermittent force is especially applicable; and it is for the benefit of this, the more numerous class of patients, that the use of this character of force is recommended.

If continued pressure be increased so that the rate of motion will be carried near to the degree equal to the highest that is attainable by the intermittent process, it is very liable to overstep the boundary and cause pain, not only because there are no periods of rest for the tissues to recuperate, but also because it is difficult to gauge tension. Even if it were possible to do this, then there would remain, with such devices as strings and elastic rubber, the difficulty of maintaining cleanliness. An attempt has been made to meet this objection by asserting that the rinsing of the mouth with disinfectants is sufficient, but disinfecting filth is not removing it, nor does it prevent the evils arising from it. If plates are properly made, and are fitted so that they are easily removed and cleansed, the objection on the score of uncleanliness is met, but in no other way. If, in addition, the tension can be made strong enough to move the teeth, and yet not act so powerfully as to cause a dragging sensation, and if the plates can be kept firmly in place, the results would, as before said, in many cases be satisfactory.

It has often been asserted that continued force only causes pain for a few hours after the commencement of its application, and that soon after there is no pain experienced. To admit that pain is experienced at all is sufficient evidence of indifference for the feelings of the patient, and to assert that there is none after a few hours can only be regarded as showing an equal indifference in observation, for thinking men know that because a patient has learned to endure silently that which causes inflammation and swelling around the teeth, it is no proof that nervous exhaustion is not going on. If a dentist would try to regulate his own teeth by this plan he would learn what the facts are. The older the patient, the more evident these facts become.

Another advantage in the use of the screw is the avoidance of the necessity of using cap-plates upon the teeth, for preventing the cusps from interfering with each other, while one is being carried over another, as, for instance, in operations for widening the upper arch—a matter worthy of consideration, as such plates are liable to injure the surface of the enamel under them. When teeth that are being moved are firmly held with unyielding devices, the cusps will not play back and forth when striking on the inclined surfaces of the opposite teeth, but they will move up the side and over the antagonizing cusps. Besides this it is found that sometimes, in widening an upper arch, the rigidity of the teeth that are being moved will, by striking on the inclined lingual side of opposing cusps, cause the lower teeth to move outward also; this following of the opposing teeth, however, is only noticed in cases of long cusps, and with these it so seldom occurs that it must be set down as unreliable.

If the trend of the argument to this point is understood, it will be readily seen that, although it seems more difficult to carry and confine by elastic materials the rate of motion of teeth so near to the boundary line of the pathological condition of the tissues without causing pain than it is by the use of devices acting upon the principles of co-ordinated mechanics, the difficulty by the use of elastics will be still more apparent in cases where it is necessary to hurry the rate beyond the degree compatible with the normal functions of the tissues in which pain must be endured in order to bridge and gain a difficult point, a condition of circumstances where periods of rest between the periods of force are of such benefit that, even if considerable pain is caused at first, it can be tolerated because it gradually passes away, and leaves time for the energies to recuperate. If pain is thus broken by intervals of rest, as in the use of co-ordinated mechanics, the comparative relief between the tightening processes encourages the patient.[1]

---

[1] DOES THE SCREW CAUSE CONTINUOUS PROGRESS OF THE OPERATION?—It has been asserted that if a screw is used the only benefit to be derived from it by the tooth is confined within twenty minutes after the screw has been advanced upon the tooth, and that the screw is doing no good after that time until it is again turned. This assertion is entirely erroneous; instead of the good derived from the screw being confined within the few minutes immediately following its advance, little or no change takes place during this time further than that the tooth and the alveolar tissues are placed in such relations by the force upon the tooth that the conditions are favorable to the carrying on of the retrogressive changes in the alveolar tissue that are necessary to let the tooth move—changes that can only be brought about some time after the force is applied. To sum up, force is first applied, and then as a cause the tooth bears against the wall of the socket, which by this bearing is induced to undergo changes which liberate it by taking away the parts that are receiving the pressure, or by so modifying its constitution that it yields, and having yielded sufficiently to liberate itself from the crowded condition it settles down in the course of a few hours into acceptance of the new relations, and if left to remain so undisturbed it will in time take on by second nature a condition of normality, the same status and relation of parts that is desired by the operator after having completed the case; but to economize time, instead of permitting this recalcification fully to take place, the operator endeavors to follow up his advantage by re-tightening the screw upon the teeth while the tissues are in their softest condition, and thus compels the continuation of the change that nature brings about for liberating tissues from pressure; *i. e.*, the tooth moves not by pressure *per se*, but by nature so modifying the alveolar tissues as to rid itself of restraint caused by the pressure; a change that never takes place immediately after the application of force. If this is so, it may be asked, how do the changes by intermittent force differ from those by continued force? The difference is that with intermittent force the tissues have time to act and rest, while with continued force, unless very weakly applied, the energies of the tissues undergoing changes are liable to become overtaxed and painful in the hurry and complexity of conditions brought about by being so closely chased by (continued) pressure. I have said that the teeth never move immediately upon the application of force; this needs some qualification, for the softness of the socket membrane permits slight yielding under pressure when first applied, and after the decalcifying process commences in the alveolus. This renders it possible to move a tooth (slightly) immediately upon renewal of pressure, but this is the result of softening changes in the tissues brought by the lapse of time after the previous application of force.

There is another phase of the question which, in order to arrive at a fair understanding of the subject, should be considered. In the choice of plans for constructing apparatus, the operator should be governed by the seriousness of the case as well as by the degree of his own ability, for that which would be highly scientific, so far as the application of cause to effect is concerned, may in some cases be a superfluous expenditure of effort. The raising of a sunken vessel may require the application of the highest principles of mechanics in order to accomplish it with ease and safety, but to make great preparations to raise an apple from the ground would be absurd; while the former can be more scientifically accomplished by derricks, pulleys and screws, it would be much the easier plan to raise the apple by stooping and picking it up. So in regard to moving teeth: while the most scientific method of performing some operations may require apparatus acting upon strict principles of co-ordinated mechanics, in order that they may be held under perfect control, many cases are so simple,—the teeth requiring only slight assistance to cause them to move into line,—that the use of complicated apparatus would be not only unnecessary, but would be like making "much ado about nothing." A gold apparatus constructed to act upon the principle of screws might be best to move a cuspid in a person forty years of age, but such an apparatus applied to a child would be no more efficient, perhaps less so, than a simple hard-rubber inclined plane. We might go further, and say that although the lateral movement of overcrowded incisors in an adult jaw may best be accomplished by the use of screws, in the correction of such teeth in children they might not be as efficient as elastic rubber rings stretched among the teeth in such a manner as to draw them in the proper directions. This is, also, true of wire springs.

Although these qualifications are intended to show the apparent exceptions, it is not intended to support the statement sometimes made that the use of complicated devices, requiring high mechanical skill, should not be encouraged, on the ground that but "few persons are capable of making them." Inventive ability, accompanied by manipulative skill, needs no argument to uphold itself. It always succeeds, in spite of adverse criticism; indeed, incorrect or baseless adverse criticism often stimulates ingenuity to oppose it, for the sake of proving its absurdity, if for no other purpose.

It is well to remember that while there are great differences in the degree of usefulness of the various kinds of apparatus constructed for the same class of operations, there is more than one way of making apparatus that will be equally useful. Two differently made devices, equally complex, and requiring equal skill, may both bring about equally valuable results. So may devices made on entirely different plans, but founded on the same principles, be equally practicable (except perhaps in the matter of convenience to the patient), though one may require great skill, and the other but little.

These suggestions are not intended to imply that roughly constructed apparatus, rudely managed, is all that is necessary, nor is it asserted that all teeth can be moved painlessly by the plans suggested or by any other. No one can provide against all emergencies that may arise, for, besides breakage of the apparatus in attempts at alteration, it is not always easy to fit it to ill-shaped teeth. It must be admitted that many people seem unable to discriminate between the relative value of different apparatus sufficiently to pronounce what is best. It is hardly necessary to say that to grasp only a few points of a theory, and then rush into operations, is a course very liable to lead to dilemmas from which it is difficult to emerge. Teeth are not to be regulated by simply throwing a piece of apparatus in the mouth and leaving it for nature to work out the cure, as she sometimes does with a dose of medicine. The apparatus should be of the right kind, rightly made, rightly applied, and rightly guided.

When the suggestion of taking advantage of physiological functions was first advanced, great opposition was made by some members of the old school, perhaps from prejudice in favor of established methods, or because they had noticed that very weak continued force sometimes occasioned but little inconvenience. It seemed as if it were thought that because the tissues of some people could undergo considerable interference without suffering, it must be so with all. An experienced observer, however, notices that the majority are subjected to pain under such treatment.

Although some dentists (in public) profess to be guided by eclecticism, and assert that in their practice they select from all plans the one best suited to the case in hand, yet in private continue to use old and crude methods, the profession generally is making honest endeavors to investigate the matter, and is practising (more and more) the plan of using intermittent force whenever possible. Many of those who at first strongly opposed it, now appear to accept most of its cardinal principles ; and others, although failing to admit openly that there is a limit to the degree of pressure proper to each case, indirectly imply its acceptance through different words meaning practically the same thing, and directly by adopting the plan of construction and method of operating the kind of apparatus recommended.

As before suggested, this philosophy is also applicable to surgical operations, such as ligation of tumors, dilatation of strictures, etc. Had this plan been tried with the Siamese twins, probably they might have been safely and painlessly separated by the careful use of a loop of gold or platinum wire intermittently tightened every day for several months, even if there had been considerable nerve and vascular connection between them, which the post-mortem examination showed was not the case. The connection of these tissues was very slight, so much so that it was said the twins died

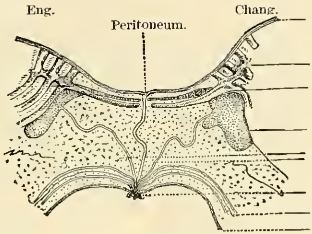


FIG. 78.—Section view of the Band of Union between the Siamese Twins.

from different causes; one from disease, the other from nervous shock after the death of his brother.[1]

Summary.—Positive and Probable Mechanics.—As a result of these discussions, the mechanical appliances for regulating teeth are now classified according to the different principles of mechanics on which they are constructed. and are known as the probable and the positive;[2] so called because one is certain and definite in action, while the other is not. These two plans not only act upon different mechanical principles, but also, as suggested in previous chapters, are thought to be capable of exercising peculiar character-

[1] While I was attending one of the Medical Colleges in Philadelphia, during the winter of 1873–74, the dissection of this band of union took place. As the matter was of considerable interest to the students of the different colleges at the time, the several professors interested explained it before the classes. Fig. 78 is a sectional view of this band, drawn at the time by the author from explanations and black-board illustrations by Dr. Pancoast, showing approximately the relations of the different tissues. The connection between the livers was no thicker than a penknife blade.

[2] First so denominated and explained in "Dental Comos," Jan. 1878 (A).

istic influences upon the functions of the tissues involved. The plan of construction by probable mechanics implies the use of elastic materials, such as springs and rubber, in such a way that a continued force is maintained upon the teeth to be moved; the management of which force is not only usually beyond the control of the patient, but is also difficult even for the dentist to so manage as to harmonize sufficiently with physiological functions, to insure the highest success with the least pain in the majority of cases.

The positive plan consists in constructing the apparatus in such a way that the force acts intermittently at will, to any desired degree, and is not only manageable by the dentist, but also by the patient, who, as before said, is really the best judge of the greatest degree of force that can be applied without causing pain.

This intermittent principle of action may be approximately reached by the use of the old and well-known wooden wedges, pegs set in a plate, metallic fingers projecting from the plate, so that they may reach out to bear upon the teeth by being occasionally bent, or by the inclined plane, but generally can be better and more accurately applied by the use of the screw.

If the double process of retrogressive metamorphosis and absorption and formation of new tissue, when kept within certain limits, is painless, and if pain is the result of overstepping the domain of healthy action, it is evident that the painless method is more scientific because more humane. Again, if pain is the result of perverted physiological action, whether caused by continued force or by too great a degree of intermittent force, it logically follows that,—notwithstanding the circumstances of cases may justify it at certain periods in some very difficult operations, or even where the saving of time or money is a matter of consideration, it cannot be denied that to the extent that pain is unnecessary it is wrong to cause it, and that to the degree that pain is caused it is a violation of the law of harmony. This statement, however, is not intended and should not be regarded as meaning that pain or inflammation alone is evidence of malpractice.

If intermittent force of a definite degree, alternated with proper intervals of rest, will more generally attain the highest success with the least pain and least annoyance to the patient, then the interests of humanity suggest that, as a general rule in adult cases, teeth should be regulated by this plan whenever circumstances will permit. I say "whenever circumstances will permit," for every dentist knows that the conditions are sometimes such, owing to the shape and location of the crowns of the teeth, as to render it impossible to use such devices. It is a well-understood maxim that the most scientific way of doing a thing is the way which is best under the circumstances. These remarks, as repeatedly suggested, are not intended to imply that such devices as act upon the positive principles of mechanical action should be generally used for patients at an early age.

To differentiate more clearly, I will briefly repeat that, while the old plans of constructing a regulating apparatus only recognized one thing as essential,—force, no matter of what character, or, as one essayist put it, "it matters little whether the pressure be continuous or intermittent, since the results are the same," implying that the results *are* the same, and not even regarding the usual concomitant of such devices (filthiness) as worthy of consideration,—I claim that the character as well as the degree of force can and does govern the question of pain; that the tissues will always painlessly tolerate a proper degree of intermittent force if not too frequently repeated, but that any cleanly mechanical apparatus which can be controlled at will so as to attain these ends, whether the force be from screws or other things, is allowable when operated with these physiological functions in view. In this work I shall illustrate several regulating devices, constructed with a view to obtaining from elastic materials a value more nearly approximating that derived from the screw than is obtained from devices made in the old-fashioned ways. This end is reached by combining both so as to secure firmness and delicacy of anchors with adjustable rubber rings, thus reducing inaccuracy of direction and degree of force, and inconvenience from clumsiness and difficulty of management, to the minimum.[1] The main principles of the system, theoretically and practically, may be summed up as follows :

PRINCIPLES OF THE AUTHOR'S THEORY OF PRACTICE.

1st. A recognition of physiological functions as factors in operations.

2d. The recognition of the benefit derived from the law of labor and rest to the tissues involved.

3d. Operating the apparatus within the limits of the physiological functions, whether moving teeth by absorption or by bending of the alveolar tissue.

4th. Construction of apparatus in such manner that force applied can be kept under control of the patient.

5th. That while apparatus constructed so that it will exert force continuously, if properly made and judiciously applied, will, under favorable circumstances, move teeth in accordance with the physiological functions of the tissues, apparatus constructed with the view of acting intermittently at will is more scientific because always capable of exactness of control, holding the ground gained, and also permitting the patient, as well as the operator, to take advantage of the benefit derived from the law of labor and rest.

[1] These devices are shown in Part XV., and elsewhere in Vol. 2. Explained in a Lecture by the author before Brooklyn Dental Society, Feb., 1888.

PART V.

Nomenclature.

CHAPTER XVII.

NOMENCLATURE OF POSITION OF TEETH.

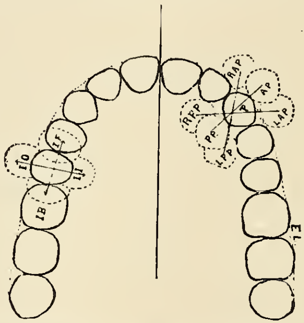
IN order to clearly indicate the position of surface disease of the teeth, a certain language or nomenclature has been established by which any particular point upon a tooth may be easily and readily designated. Thus, we speak of a cavity as being in the distal or bucco-distal surface of the left superior first molar, etc. Without some such generally understood nomenclature or system of terms regarding irregularities of the teeth, it would be difficult to express our ideas briefly and accurately. I will repeat a nomenclature suggested by me several years ago, which, having proved helpful,[1] will be frequently used in this work. It is not difficult to understand, and may be easily learned in thirty minutes.

The dotted line, E, L, Fig. 79, marking the outer surface of the dental arch, should be regarded as the base line to which the nomenclature of position refers.

Position. — A position anywhere outside of this line, whether labial or buccal, is anterior, while a position inside, and next to the tongue, is posterior, thus: When a tooth is situated in its right place, and in a proper attitude upon the esthetic line, it is in position. If a tooth is directly outside of its proper position on the line, it is in an anterior position. If a tooth is directly inside of its proper position

[1] Published in "Dental Cosmos," June, 1878, p. 302.

on the line, it is in the posterior position. If a tooth is situated to the right or to the left of either of the two beforenamed positions, we may say it is in the right or in the left anterior or posterior position, as the case may be. If any of the six front teeth of either jaw have, in addition to these positions, a leaning posture, the word "inclined" or "inclining," used with the words "right" or "left," and with all teeth back of the cuspids the word "forward" or "backward," associated with the other and suitable descriptive words, will indicate the direction of the inclination.



PATIENT'S RIGHT. PATIENT'S LEFT.

FIG. 79.—Abbreviations of Nomenclature of Position of Teeth (A).

In Fig. 79 the part of the diagram marked "patient's left" illustrates by abbreviations and dotted lines the nomenclature of the seven positions of a cuspid. The four inclined attitudes of the right second bicuspid are similarly shown in the "patient's right."

The nomenclature of positions of all teeth may be put in abbreviations as follows: If the left upper cuspid tooth is in position, it is indicated by P; if it is in the anterior position, A P; if in the right anterior position, R A P; if in the left anterior position, L A P; in the posterior position, P P; in the left posterior position, L P P; in the right, R P P. If the tooth be in any of these positions, and have also a leaning attitude, as before said, we may express the attitude by prefixing the word "inclined." For illustration, when the right upper second bicuspid is in position, and is "inclined forward" I F; "backward" I B; we may also say that the bicuspid or molar is in "position," but inclines forward or backward, inwardly or outwardly, as the case may be. These terms, together with the well-known words, "instanding" and "outstanding," which are often used for teeth which are located posteriorly or anteriorly to their proper positions, will enable dentists to express their ideas, easily and clearly, as to the exact location of malposed teeth. They will, also, by the habitual use of these terms (as synonyms), convey to their own minds, and intelligently impart to their patients, the relative position of any tooth or teeth, not on the esthetic line, which ought to be corrected.

PART VI.

Explanation of the Principles

IN

Construction of Regulating Apparatus.

CHAPTER XVIII.

GENERAL REMARKS.—POSITIVE AND PROBABLE MECHANICS.—VARIETIES OF APPARATUS.—COMPLICATED VS. SIMPLE APPARATUS.

REGULATING devices, like most other machines, are constructed upon one or more of the fundamental principles of mechanics: namely, the lever, the wheel and axle, the pulley, the inclined plane, the wedge, the screw, and elasticity; but as the wheel and axle and pulley are only modifications of the lever, and the wedge and screw modifications of the inclined plane, these may be regarded as only two. Whether the principle of elasticity can be included in these two, there is some doubt, and so long as there is a doubt we will speak of it as a distinctive principle. It has been said that all regulating apparatus constructed purely upon the screw principle, belong to the positive plan of mechanism, and are capable of an intermittent motion of any degree at will; while devices constructed so as to act purely upon the principle of elasticity, and which are not capable of causing an intermittent force that can be made to act at will, but are continuous in their action, belong to the probable plan.

The want of system in regulating teeth has brought into existence a variety of apparatus, some of which have proved useful, but a larger number have failed. Many are constructed upon the positive basis, but the greater number on the probable, and a few combine separate features of each.

Some devices have been successful, because ingeniously constructed and skillfully managed. Some have failed, because, through indolence or ignorance, they have been inaccurately constructed. Others have failed, not from lack of nice workmanship, but from having been made upon improper principles.

The cases of irregularity are so various, each apparently requiring more or less difference in construction of the appliances used to remove it, that an impression is prevalent that it is impossible to establish any system of principles, the knowledge of which would facilitate the efforts of the dentist.

At first, it appeared so to the writer ; but upon reflection he was surprised to find how simple and few are the mechanisms necessary to accomplish nearly all that is desired, whether turning, drawing, pushing, elevating or depressing the teeth, or holding them in place.

Some dentists prefer to use devices made upon the principle of positive mechanics, others upon the probable, and there are those who assert that "the tissues with their natural force, constitute the best regulator; because the use of any kind of device is injurious to the teeth." This depends more upon the dentist and patient than upon the apparatus, but cleanliness is all-important in the matter. So far as the character of force applied is concerned, I have never seen in my own practice a case that was injured by the use of intermittently acting apparatus, but a dentist once told me of an instance where he tried to move a single tooth one-fourth of an inch in two days, which resulted in the patient declining to further endure the operation. Dentists have also shown me cases in which instruments acting upon the probable principle (continued force) were causing great and unnecessary pain. This proves that both plans can be abused either by ignorance or by indifference.

A short time ago, I extracted several teeth, having tried in vain for two years to fasten them in their sockets. The sockets of these teeth had been hopelessly ruined by the use of strings and elastics in operations before I accepted the case. Compared with the average results from continued force (even by experts), I think it can be said that the intermittent is far less dangerous. Many patients have been subjected to pain and ill-health consequent upon diseased tissues, and many have even been rendered uncomfortable for life by ill-advised attempts at cheap methods of regulating teeth by the use, or rather the abuse, of instruments; especially is this true of strings and elastic rubber. There are, however, a few fixtures operated by continued force, such as act through the agency of spring wire, that are comparatively safe. As many dentists prefer devices constructed upon the probable plan, and as such devices are useful in some adult cases and especially valuable for small children, apparatus based upon this principle as well as upon the other, will be explained in such a way that I think a student, having a fair degree of mechanical ability, will be enabled to manufacture all necessary appliances.

The attainment of the simplest method of making devices has been a desideratum for many years, but it has for some time been evident that the day will come when the elements that are necessary to construct apparatus will be so systematized and simplified that the latter will be kept in stock (in parts, not made up) at dental depots, in readiness for the profession at large, so that they may be ordered by catalogued numbers to suit the needs of any case. With such facilities at command, the dentist at the lamp will be able in a few moments, by uniting the parts, to construct any apparatus, of any size, at the minimum cost of time and money. Though I never attempted it, I at one time thought that perhaps devices might be kept, in stock, fully made up, but, with the exception of a few things, such for instance, as jacks, I now think it would not prove satisfactory either to manufacturer or dentist. As before said, it is not claimed that the use of any one set of apparatus under all circumstances is a guarantee against difficulties, for these are liable to arise under any plan, rendering it necessary to resort to others to gain some points. Experience has taught that whenever results have not been such as were anticipated from the probable as well as the positively acting apparatus, the want of success was not always due to the circumstances of the case, but to some misjudgment as to the extent of force and resistance between the apparatus, teeth, and the other tissues, or else to want of skill in making the devices. (See Note on page 249.)

Two cases apparently similar in the shape, size, length and arrangement of the teeth, may require very different apparatus in order to obtain the best results. Even if it were possible clearly to point out all the various shades of difference in requirements on paper, it would be confusing. I will, therefore, confine my remarks to what I think are the best methods of treatment, and explain the essential features of the devices used.

Complicated versus Simple Apparatus.—Complicated apparatus for regulating teeth have been generally regarded not only more expensive but less useful than the simpler forms. This idea, as also the assertion that "most people are incapable of managing complicated mechanisms," may have some foundation, but it does not necessarily follow that either is always true. Simplicity is a virtue, but crudity is not; simplicity in the construction of apparatus is valuable when it is combined with usefulness and comfort, but to urge simplicity, when it is apparent that mere cheapness is the aim, is not sound teaching. Complexity in regulating apparatus may be accompanied with expense, but in skillful hands it may in the end be the most economical; because, when accurately constructed and properly applied, the work goes straight on to success with but little effort.

Simple machines in all departments of art and science have been found valuable, but it has also been proved in a multitude of instances that complicated and expensive mechanisms are more valuable, because more practicable. Is not the improved steam-engine of to-day much superior to the primitive engine, and the Hoe printing-press infinitely more effective than that used by Guttenberg?

Although I have obtained very satisfactory results from complicated devices, I have hesitated as to attempting an explanation of their construction, fearing that it might discourage some students in the profession; but, upon reconsideration I have concluded that, even for the benefit of a few, it is best to explain such as I have found useful, as a form of lesson that may encourage efforts at further improvements. In constructing apparatus, the object should be to perform the operation in the most scientific manner, with as little inconvenience to the patient and operator as possible, and if complicated apparatus will accomplish this end best, it should be used, even if it involves the expenditure of more study and labor. But, in some cases, the time necessary to construct complicated devices, together with inconvenience in wearing them, if there be any, should be weighed against their usefulness; the apparatus which may be practicable for one person may not be so for another. Again, circumstances, such as financial considerations, may contra-indicate the use of expensive devices. With these introductory remarks we will now proceed to explain the construction of regulating apparatus, independently of their application to cases in practice, In so doing I shall follow a classified order that will enable

14

the reader to memorize their relations, so that he will be able to refer to them readily. In Vol. 2 will be found in classified order the various conditions of irregularities of the teeth, and the application of the instruments used in the best current methods for their treatment.

Before proceeding, however, I desire to call attention to a somewhat personal matter. I refer to the question of priority of invention. In explaining the various devices mentioned in the work, it is my sincere wish to give credit to whom credit belongs in this matter of priority. But, in doing so, I cannot pretend to infallibility, for, as all readers know, there are numerous instances in which different persons, quite independently of each other, have originated the same idea, or invention, and in such cases publication of the device of the later inventor sometimes secures to him the credit of priority over the earlier one, who has omitted to make his public.

In view of the great number of inventions, improvements, or modifications, which, so far as the author knew, were original with him, such claims became especially delicate: and for this reason, whenever he has found that another inventor had antedated him, the credit of priority has been transferred to that inventor. Yet, it is possible that some devices still claimed by the author really belong to others, but however this may be, he has aimed to do justice to all. The greatest benefit that can be derived from recording the descriptions of devices is, after all, the protection of the profession from unfounded claims through patent rights; and it is this consideration more than any other that has induced the author to assert his claim publicly to any of his inventions. I mention this point, because I have more than once been urged to relinquish my claims in order that others might secure Letters-Patent.

CHAPTER XIX.

PLATES.

EFFECT OF FORCES ON ANCHOR-PLATES.—ANCHOR-CLAMP-BANDS.—CLASPS.—PLATES OPERATED BY PEGS.—SPRINGS.—SCREWS.

PLATE devices, which were recommended by writers many years ago, and which are used, also, at the present day by a large number of practitioners, derived their name from the original form, a large plate then made of metal adapted to the roof of the mouth, and attached by strings or clasps to one or more firm teeth on each side of the jaw. This served as an anchorage to which the irregular teeth were attached by means of ligatures, which being occasionally re-tightened caused a tension upon the teeth in the direction desired. Gold bands are often called plates, but this is misnomer. In the days of Mr. Fox, when "jumping" of the teeth was desired, the jaws were sometimes hindered from occluding by the interposition of blocks of bone fixed to a band, but now the block constitutes a portion of the anchor plate, which is made of hard-rubber instead of metal.

Regulating devices based upon the plan of plates are generally clumsy, yet for some cases they are not only efficient, but are regarded by a few honored operators as having great merits. They are certainly valuable for increasing the degree of anchorage, in some cases in which teeth are lost, leaving the remainder insufficient for this purpose, as will be shown in Vol. 2. The construction of these devices varies much, but the principle is the same in all. Sometimes the regulating device, as now used, serves not only as anchorage for the attachment of the engine of force, but as the regulator itself. In shape, the plate varies from a partial or entire form of the letter U to a full plate covering the entire roof of the mouth, and even in some cases covering the teeth.

The plate alone may serve to widen the arch, if it be made wide enough to crowd against the teeth, but this device requires frequent renewal, each succeeding plate needing to be made wider than the previous one. This plan is, therefore, seldom adopted, operators preferring to fix upon the one plate other things, such as spring wire, wooden pegs, screws, etc., that will press upon the teeth and meet the changing requirements incident to the changes in their position. Plates may be fixed to teeth by covering the crowns tightly; or by strings; finger points extending between the teeth, dovetailing the spaces; clasps and anchor-bands; or by the use of ferules cemented upon the teeth to serve as shoulders. The usual method of connecting the teeth to plates is by catching a package ring or a ring cut from rubber tubing or from sheet rubber, such as is used for coffer-dam, over a knob or hook on the plate, then stretching the rubber over the tooth or teeth to be moved. Of course, such plates should, if necessary, be cut away in proper places to make room for the teeth to be moved along.

Effect of Force upon the Plate.—In Part IX., the effect of force in different directions upon the teeth will be considered. We have now to study the reactive effect of force upon the instrument itself, as success often depends much upon the location of the point of attachment of the drawing or pushing device on the anchor apparatus.

Apparatus firmly fastened to the teeth by means of screw clamp-bands, or ferules set with cement, afford the best guarantee against dislodgment, because, by their use, force may be made to act from and toward almost any place, and in any desired direction, without danger of the slipping, or starting of the anchorage. But, if roof plates made as shown in Figs. 80 and 81 are used for anchorage, the case may be quite different; especially so, if the roof plate is retained simply by a close fit along the lingual surfaces of the teeth, even if aided by points projected from the plate between the teeth, as a slight degree of traction upon it will dislodge it. Unaided roof plates are at best weak anchorages; they easily work loose, and so

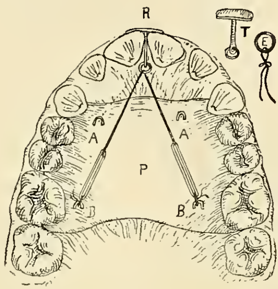


FIG. 80.—Different Effects of Force upon plates when Applied at Different Places.

cause no little annoyance. Even if the plate is an accurate fit at first, the pressure upon the teeth consequent to the draught upon the plate will often move the anchor teeth sufficiently to loosen the plate. However, there are other points upon which success or failure greatly depends. I refer to the relation of the line of draught to that of the plane of the bearings of the plate upon the teeth, and the point of the attachment of the draught to it.

As an illustration, should a roof plate be made as shown in Figs. 80 and 81 for an anchorage, from which to draw back protruding front upper teeth by means of elastic rubber, if the draught be made from the posterior portion of the plate P, as at B, B, it will be seen that, as the line of draught does not correspond with the plane of the several points of bearings of the plate upon the teeth, the plate along the posterior borders will tend to rise and become dislodged. The tendency of this movement is in the direction shown by dotted lines, as compared with the plain lines in Fig. 81. If the draught be from the points A, A, on the anterior portion of the plate P, as indicated by the dotted lines R, A, Fig. 80, or the black line R, A, Fig. 81, the liability of dislodging the plate would be much less. Differences in the shape of teeth also necessitate corresponding differences in the matter of securing plates, but I think it may be said as a general

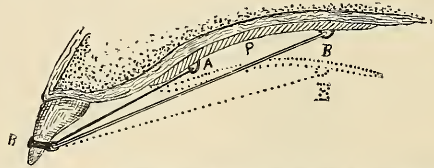


FIG. 81.—Section view of Upper Jaw, showing relation of two lines of Draught to a Plate.

rule, that, to secure the least liability of dislodgement of plain anchor plates, the point of attachment for draught fixtures should be somewhere within the anterior half of the plate; the position of the point depending upon the contour of the alveolar ridge and roof of the mouth, and the relative position of the bearings upon the anchor teeth, as well as the points of attachments on the teeth to be moved.

An old device for moving individual teeth inward, which is a favorite with some practitioners, consists of a plate, and a rubber elastic; the plate, which serves as anchorage, covers the roof of the mouth and is fastened to the side teeth with strings, as shown in Fig. 82. Over a knob or hook vulcanized into the plate at some convenient point, which should not be posterior to the middle, is caught an elastic ring cut from tubing, thence it is stretched over the outstanding tooth to be drawn in. If the tooth is of such a shape or stands in such a position that it will not retain the rubber, or if it requires to be turned, a thin platinum or gold ferule, E, of the length of the crown, cemented upon it with

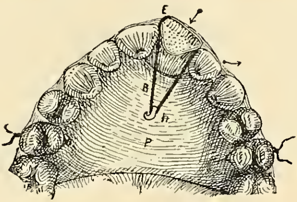


FIG. 82.—Elastic Rubber with Plate Anchorage.

phosphate of zinc, will meet the difficulty. This ferule, especially if it has a hook soldered to it, affords a very firm attachment of the tension cord. The combination of the ferules with the plates constitutes a simple apparatus, and one that, with the exception of the ferule element, can be easily removed to be cleansed, and as easily returned to place.

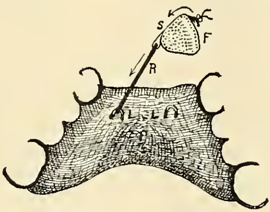


FIG. 83.– Plate Anchored with Clasps.

Another old and better method of fastening an anchor plate is by the use of gold clasps. For attachment of elastics or strings to plates there is nothing more valuable and convenient than wire staples vulcanized into them as shown by L, L, in Fig. 83, which illustrates a device for turning an upper central by means of an elastic ring, R, caught by a string, S, on a hook soldered to a gold ferule, F, cemented around the tooth. To fix the staples so that they will not get out of place while the device is being made, one end of the wire, or both ends are forced into the cast, leaving the curved portion of the wire projecting above. The clasps are then placed on the teeth of the cast, covered with rubber, and vulcanized. "Baking" staples in, however, is not necessary, as they may subsequently be fixed in holes bored through the plates. After passing the two ends of the wire through the plate they should be

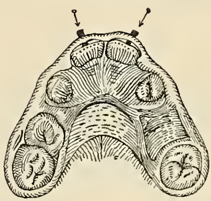


FIG. 84.—Appearance of a Peg Plate when first Applied (Magitot).

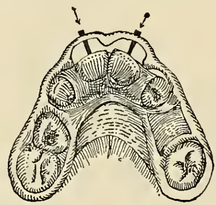


FIG. 85.—Appearance of the same Case at a later Stage (Magitot).

bent or headed down to prevent them from being pulled out.

Wooden-peg Devices.—Figs. 84 and 85 illustrate a device described in Magitot's work, which in principle is the same as described later by other authors. The invention is accredited to Drs. Redman and Richardson. This device is for regulating the upper teeth by means of wooden pegs set in holes through different places in plate, the pegs bearing upon the teeth so that they will tend to move in the direction desired. The device may be skeleton, as shown in Fig. 84, or plate-like, as illustrated by Fig. 86, which is taken from the same work. Formerly these things were made of metal, but now they are generally of hard rubber, fitted accurately to the alveolar ridge and teeth, but cut away in places off against the teeth to be moved, so as to make room for them to advance when pressed upon by the pegs, which are occasionally forced more and more through the holes. This kind of device, which was formerly used more than at present, is practicable but clumsy, and when tied to the teeth with strings to hold it in place it is difficult to keep clean. It has, however, one advantage, cheapness. I have seen several cases of irregularity successfully corrected by this method, and have heard a few operators speak highly of it. In place of wooden pegs gold screws

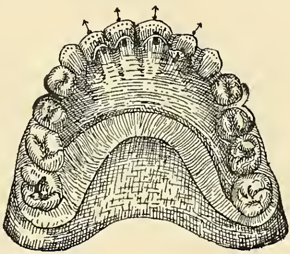


Fig. 86.—Peg Plate (Magitot).

might be used to advantage, as in principle was practised in the cases of Dr. Gaine and described in Part II., Chapter 3. The cuts of the above-mentioned cases so clearly show the principle of construction of these devices that further explanation seems unnecessary. Besides the objection of want of cleanliness, when made as above illustrated, is the insecurity of their anchorage, as they depend upon strings and projections of the plate between the teeth to hold them in place. Sometimes clasps fixed to these devices and sprung over the bell-shape of the crowns of the anchor teeth are more practicable.

To fully overcome the difficulty of weakness of anchorage, I devised a modification which is thought to be an improvement, namely, the adding of a gold or platinum anchor screw clamp-band to one or both sides of the plate, substantially as shown in Figs. 87 and 88. These clamps are fixed into the plate by means of lugs or tongues extending from them, which are vulcanized in when the plate is made. By this means the fixedness of the anchorage is insured beyond a doubt, so that when the pegs or gold screws (if used) are forced against the teeth, they will bear firmly and not slide along the surface of the teeth. Even if applied to the lingual surfaces, as illustrated in Fig. 86,

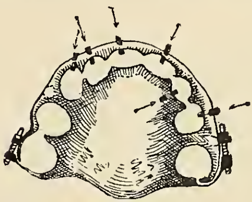


Fig. 87.—Peg Plate with Screw Anchorage (A).

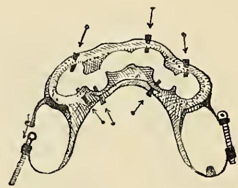


Fig. 88.—Peg Plate with Clamp-band Anchorage (A).

they will sometimes rest sufficiently firm to move them outward. This is substantially the plan of anchorage before referred to, which I devised several years ago, for fastening all kinds of devices of which plates constitute a portion. Where great firmness is desired I sometimes hold plates in place by the use of these clamp-bands independently placed around some of the side teeth after the plates are put in place, but generally I prefer to vulcanize them to the edge of the plate, as illustrated by Fig. 89. This plan renders the plate so firm that it cannot work loose.

Fig. 89 illustrates a plate for attachment of an elastic rubber ring for moving outstanding anterior teeth, and which is also equally adapted for turning teeth into position. These elastics are attached to staples made of gold or platinum wire riveted or vulcanized into the plate as before explained.

Fig. 90 illustrates three modifications of attachments for anchoring clamp-bands into rubber plates. When it is not

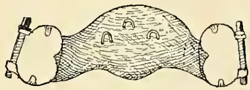


Fig. 89.—Positive Anchorage-plate (A).[1]

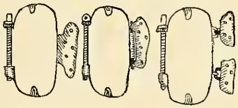


Fig. 90.—Anchorage Clamp-bands for Plates (A).

possible to use clamp-bands solidly fixed to lugs they may be made pliable by hinging them in some way to the roof plates, but this motion may also be obtained from the extreme thinness of the rigid ear soldered directly to the band. Still another plan is by means of small rings soldered to the anchor band. As clamp-bands made in various ways to suit different wants are explained later, it will not be necessary to further dwell upon them here.

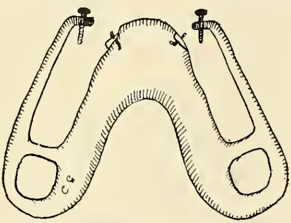


Fig. 91.—Regulating Device by Dr. Gaine.

Screw-jacks often constitute a portion of plate apparatus, and are wired or vulcanized to the plate; they also will be fully explained later.

Fig. 91, from a photo-electrotype of a sketch drawn by Dr.

[1] Anchor-band published in "Dental Cosmos," January, 1876, and in connection with a plate, January, 1888.

Gaine, shows the form of a plate with screws used by him many years ago.

Fig. 92 illustrates a hard rubber plate devised by Dr. Kingsley for forcing outward a stubborn cuspid, and to turn a central. The screws, which are of the Dwinelle pat-

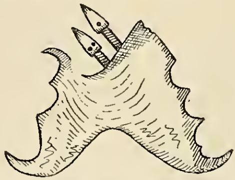


FIG. 92.—Plate Anchorage with Dwinelle Screws (Kingsley).[1]

tern, were vulcanized into the plate and then screwed back and forth afterward, to perfect the threads in the rubber. Another form of plate by the same dentist, for moving outward a single tooth, consists of a hard rubber plate, partially divided in two places on one side, thus constituting a tongue-like piece from the middle of which and into the opposite side of the plate extends a Dwinelle steel screw-jack. When the jack is lengthened, it forces the tongue outward against the tooth to be moved. The deviser does not

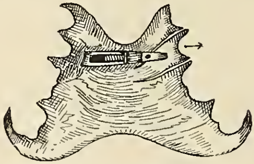


FIG. 93.—Plate Device (Kingsley).

state how he fixed these plates with sufficient firmness upon the teeth to prevent slipping, but if the plate is secured firmly, this principle of applying screw power to the teeth is practicable, though it is a question whether there is any

[1] "Johnston's Miscellany," January, 1877.

advantage to be gained by having a tongue interposed between the screw and the tooth. The assertion that contact of the jack with the tooth is detrimental to the latter is a fallacy, unless the jack is of steel with sharp serrations.

When hard rubber rings alone are placed around a side tooth to serve as anchorage for elastic rubber to draw back a stubborn cuspid tooth, the anchor tooth sometimes moves forward the same as the cuspid moves backward. This is possible, and even probable, with any kind of anchorage embracing only one tooth of one side of the mouth. Whenever it is practicable, especially in cases of weakly set side

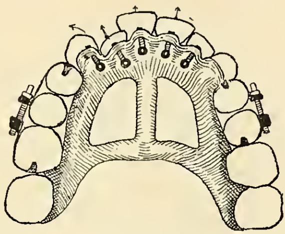


FIG. 94.—Skeleton Anchor Band Plate and Screws (A).

teeth, I sometimes prefer to use a gold skeleton device made of half-round wire for such cases, but a skeleton plate made of hard rubber with clamp-bands, as illustrated by Fig. 94, or even a full plate covering the entire hard palate and fitted snugly to the lingual walls of the teeth of both sides sometimes becomes necessary to obtain the required firmness. If a full plate is fitted properly about the several teeth, it gives a greater breadth of anchorage. Such a device is difficult to cleanse, but it can generally be depended upon for moving several teeth at one time.[1]

The object of the device illustrated by Fig. 94 was to make room for the laterals, by forcing outward the anterior

[1] Brooklyn Medical Journal, p. 26, Fig. 6 (A), July, 1888.

portion of the dental arch by means of screws passing through the corresponding part of the hard rubber plate, similar to the plan of using wooden pegs, shown in Fig. 86.

Fig. 95 A illustrates a fixture devised by Dr. Kingsley for correction of protruding upper teeth. In detail this fixture, which in principle has great merit, and which is a slight modification of a retaining fixture, devised by the same person, consists of a piece of "gold spring wire" and a plate fitted accurately to the bicuspids and molars to serve as anchorage. Its construction is as follows: Having selected a piece of wire of sufficient length to extend

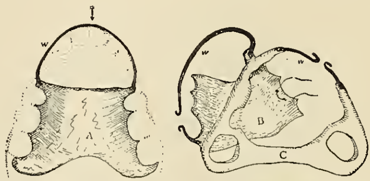


Fig. 95.—A, Single Wire Bow-spring and Plate; B, C, Double Spring and Plate (Kingsley).

from one side of the dental arch to a corresponding point on the other, the ends are hammered rough or flat, after which they are vulcanized into a plate at points off against spaces between the cuspid and bicuspid teeth. This wire, which extends along the anterior surfaces of the protruding teeth, is bent so as to bear upon them in such a manner that these teeth will be forced posteriorly. When, by the movement of the teeth, the tension of the wire is spent, the device is taken away, and the wire bent inward a short distance, then sprung upon the arch, and tied to the side teeth. This device is simple, and if the plate is firm it is practicable. Mr. Tomes, who many years ago devised a similar mechanism, used clasp anchors.

Fig. 96 illustrates a device for forcing in protruding teeth.[1] Although original with me, I found it several years after to have a close resemblance in some respects to Dr. Kingsley's device, shown in the preceding figure. There is one important difference, however, which must be regarded as a valuable improvement. This consists of the addition of the clamp-bands, B B, which vastly increases the anchorage, rendering it impossible to become dislodged. Having the wire W divided, renders the above device more effective, because each extremity can be easily bent to suit any desired variations in the degree and direction of force required by difference in the location of

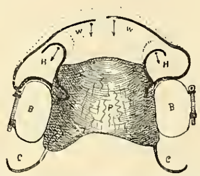


FIG. 96.—Anchor-bands and Plates with plain Arm-springs (A).

the tooth or teeth to be moved. Simply cutting the wire W, in two, however, cannot be regarded as novel, because, Dr. Kingsley had before made similar springs. See B and C, Fig. 95.[2] The spring-hooks, H H, extending from the anterior portion of the plate, are for moving back cuspids independently of the outer wires ; C, C, are gold anchor hooks.

If there is danger of moving anchor teeth, alternate pressure by bending only one wire, W, at any one time. This device without the outside wires is useful.[3]

Fig. 97 shows a modification of the last-mentioned device (Fig. 96). This differs in having the wire coiled at conven-

[1] Engraved 1887. [2] Johnston's Dental Miscellany, June, 1877. [3] See Part XV., Vol. 2.

ient points, s s, to increase the duration of the spring-power. These coils, which usually are located near the corners of the mouth, may project inwardly or outwardly from the main line of the wire, or they may be situated evenly on both

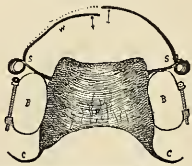


FIG. 97.—Anchor-band and Plate with Coiled Arm-springs (A).[1]

sides, the preference being given to suit the circumstances of the case. Although the long front wire w, when made in two pieces as shown in Fig. 96, is superior to the whole wire shown in Fig. 95, the former plan is not equal to the latter for retaining teeth in place after the operation.

Fig. 98 illustrates another of my earlier devices for forcing the cuspid teeth backward. Its construction is so plainly shown in the picture that it needs no further explanation. This device, although similar in construction to

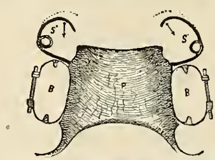


FIG. 98.—Anchor-band and Plate with Coiled Hook-springs (A).[1]

that shown in Fig. 97, can hardly be regarded as a modification of that shown in Fig. 95; but, taken as a group, these three devices, except in the elements of clamp-bands for anchoring the plates to the teeth, must be regarded as only modifications of the Kingsley plate and wire bow (Fig. 95), and the Coffin plates and their wire springs, which are well known to the profession.

[1] Engraved 1887.

In my practice I use spring wires independently of plates by fixing them directly to anchor clamp-bands (Fig. 99). As the application of these and the above devices will be illustrated in Vol. 2, they will not now be further considered.

To construct plate devices, select the proper size and length of spring gold wire or steel piano wire ; when it is bent into the desired form, one extremity is hammered flat and irregular and then fitted and fixed to the cast of the teeth, after which rubber is applied and vulcanized in the usual manner for artificial dentures. To insure sufficient

Fig. 99.—Spring-wire and two Hooks for a Rubber Ring, soldered to a Clamp-band (A).[1]

Fig. 100.—Wires for Arm-Springs.

anchorage in the plate, these wires, besides being roughened, should be bent and lodged along the thickest portions of the plate. Some of the forms of these extremities are faintly shown by dotted lines in the preceding figures. To prevent oxidation of piano wire, it should first be dipped into molten tin. (See Fig. 100.)[2]

[1] Brooklyn Medical Journal, July, 1888.

[2] Note.—When and by whom the first roof-plate with spring wires to bear against the lingual, or the buccal and labial sides of teeth, for the purpose of moving them was devised, I have not ascertained, but that they are not new must be acknowledged by all. Other persons, as well as myself, had devised various modifications of such mechanisms (with wire bearing on the inside or extending between the teeth, to be bent back so as to bear upon them outside) about fifteen years ago, and each one supposed himself to be the prior inventor, but later it was learned that all these devices had a prototype in an earlier day. I think that to Mr. P. Headridge, and Dr. Coffin and his son, of England, should be ascribed the credit of having aided largely in developing this class of devices.

Several dentists, among whom are Atkinson, Wilson, and Jackson, independently of each other, during the last few years, have devised wire regulating and retaining fixtures to be used without plates. The principle of the plan is to bend round wire so that it will rest along the dental arch in such a way that the teeth are embraced in a crib which holds steadily in place or presses upon those that are to be moved. These are anchored to the posterior teeth by being bent around so as to include two or more of them.

15

CHAPTER XX.

INCLINED PLANES.

GROUP GOLD HOOD-PLANES.—RUBBER PLANES.—GROUP FERULE PLANES.—SINGLE-TOOTH PLANES.—FRAME INCLINED PLANES.

INCLINED planes correct the teeth of one jaw by being so placed on the opposite teeth as to antagonize in definite ways. These devices, when they are used for correction of the upper teeth, are generally so fixed upon those of the lower that the upper teeth by sliding upon the inclined surface of the device will tend to move them in the direction desired.

It has been urged as an objection to inclined planes that the prevention of antagonism of the teeth that are not pressed upon by the instrument is liable to be followed by their rising in their sockets, thus causing a difficulty in subsequent occlusion of the jaws. As inclined planes are generally used to move only one or two teeth, and these for children at a tender age when teeth move rapidly by slight force, they are rarely in use long enough to cause harm. For further elucidation of this point see Chapter on Rising of the Teeth, Vol. 2.

Inclined planes were formerly made of ivory, gold or silver, but since the discovery of the process of vulcanization of rubber, these devices are usually made of this material. There are, however, cases where gold is preferable, but only because less bulky.

Fig. 101 illustrates two modifications of the former, one having one inclined ear, the other two. Originally these were made of silver, but now they are of gold or of thin platinum, afterward strengthened with gold flowed over them.

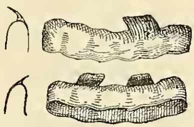


FIG. 101.—Swaged Gold Inclined-planes.

Group Gold Planes.—These are cut from plate to fit over the teeth or are made upon the principle of ferules. Of this latter variety, Fig. 102 illustrates two that are similar in shape, that were made of gold and cemented to the lower anterior teeth, each for the purpose of forcing out one of the upper centrals in children about twelve years of age. As the figures show, this kind of device consists of a ferule made large enough to embrace several teeth, then to the labial and lingual sides of the ferule are soldered the extremities of a stiff strip of 18 k. gold plate, bent on an incline so as to give the irregular tooth an outward tendency when bitten upon. To prevent the ferules from being forced, telescope-like, over the cement and teeth, the

FIG. 102.—Inclined Ferule-planes.

upper edges should bend inward. This is not exhibited in these figures, but is shown in the chapters on Retaining Devices.

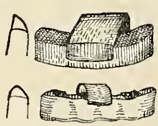
Fig. 103 illustrates a similar but adjustable device that is sometimes found useful. This differs from the others in that only one end of the inclined piece is soldered to the ferule. As said of the others, to prevent this ferule from slipping the upper edges should be bent inward.

Several years after I used these devices (Figs. 102 and 103), supposing that I originated them, Dr. W. H. Dwinelle showed me two devices (for single teeth) con-

FIG. 103.—Ferule-plane.

structed on the same plan, which he made twenty or thirty years previous. These fixtures were of silver. Catalan sixty years ago described a device, consisting of four planes soldered to a long-band. [See Chapter 11, Vol. 2.]

While this inclined plane has the merit of ease of manufacture, I do not regard it as so scientific as the full cap swaged to fit over the teeth, which may be cemented upon them or not. (Fig. 101.) The principle of this latter construction, however, is not new, for Mr. Imrie, of England, thirty years ago or earlier, devised something of this kind, though on a larger scale. He made a metallic plate to cover all the lower teeth as far back as the second molars; a bar was then soldered to the inner side of the plate in such a way as to form an inclined surface, so that when the jaws were brought together, pressure was made to bear upon the upper teeth that would tend to force them outward.



FIGS. 104, 105.—Capped Ferule-planes.

Figs. 104 and 105 illustrate two modifications of the group-ferule inclined-plane, differing from the above, however, only, in that one has a full cap soldered on the top, the other having a partial cap made of three strips of gold spanning across. Of the two, the latter is preferable because it can be easily removed by chipping out the cement from the top.

While metallic inclined planes, of a size sufficient to include several teeth, are sometimes rickety or unsatisfactory, those which are made to cover only one tooth are in general highly satisfactory, but as single-tooth "planes" do not appropriately belong to group-planes they will not be explained until later.

Group Rubber Planes.—We now come to the consideration of what is generally thought to be the best kind

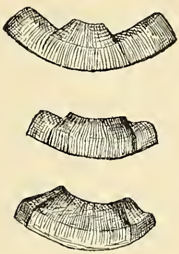
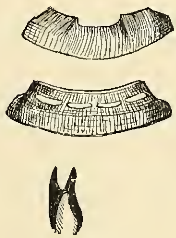


Fig. 106.



Figs. 107, 108, 109.

Figs. 106—109.—Various forms of Hard rubber Inclined Planes for lower Anterior Teeth.

of material for inclined planes; rubber vulcanized hard. This is especially valuable because it can be easily altered in shape by whittling to suit the changes in the position of the teeth at different stages of the operation. Hard rubber planes usually fit so firmly that they do not need to be cemented upon the teeth. The proper shape of inclined planes depends upon the conditions of the case; but, in brief, they are generally constructed so as to saddle over and upon, as well as around, several of the lower teeth, and extend sufficiently above their antagonizing ends to form an inclined surface. Some of these forms are shown in Figs. 106 to 109.

The plane of inclination may extend considerably above the teeth, as shown in Fig. 106, or be filed flush with them, as in Fig. 108, but this cutting away necessarily weakens the device. Upper incisors needing to be turned may sometimes be so corrected by making two inclined surfaces face each other, thus forming a groove into which the teeth strike in a manner tending to turn them (see Fig. 109). But no form of inclined plane can be depended upon for this latter purpose. This is a modification of Duval's (1820–26).

Process of making Rubber Planes.—The process of making rubber inclined planes is as follows: Supposing the case to be corrected is that of an instanding upper incisor; the first step is to take a *wax* impression of the lower front teeth, in one cup, and then an antagonizing impression of both the upper and lower anterior teeth in one piece of wax. Then, having made a plaster cast from the first impression, the antagonizing wax impression is placed upon it, and plaster poured into the indentations made by the upper teeth. These two casts are then held in their normal relations to each other by fixing them with plaster to brass antagonizing frames, or by joining the upper cast directly to the lower with plaster as in the old style. To enable these casts to be easily separated the lower one should be varnished and oiled before flowing the upper cast.

After the two casts have become sufficiently hardened, a wax form, resembling in shape the desired instrument, is moulded upon the lower teeth, after which step the upper cast is laid aside, and the lower cast with the wax inclined plane upon it is proceeded with as in the ordinary process for making plates for artificial dentures. In brief, this process is as follows: The cast with the wax plane is set in the lower portion of a flask and filled about with new plaster; then it is trimmed and oiled, after which the upper portion of the flask is placed upon the lower, and then filled with fresh plaster and the top put on. After the plaster is set the flasks are separated, the wax removed, plaster and teeth trimmed carefully, and then the rubber is substituted for the wax, after which the flasks are screwed together, and placed in the vulcanizer. If the piece is of considerable bulk, I generally require one hour to raise the heat to 310° and two hours more to complete the vulcanization; this is in order to guard against sponginess of the rubber.

When the device is applied to the teeth, the patient should be instructed to bite upon it often, but not with sufficient force to cause the socket of the tooth acted upon to become too painful. Inclined planes should fit sufficiently tight upon the lower teeth to prevent them from slipping off during sleep. The success of this device depends largely

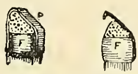


FIG. 110.—Gold Inclined-planes.

FIG. 111.—Modifications of same.

on its being continually worn until the teeth are forced into the desired position. Of course, cleanliness should be maintained.

Metallic Single-tooth Planes.—Fig. 110 illustrates two forms of planes devised by Dr. Dwinelle (nearly thirty years ago) to fit on single teeth of one jaw to move single teeth on the opposite. These devices, which in principle of construction are the same as the group planes shown in Figs. 102, 103 (and which were independently re-invented by myself, Dr. Guilford, and others, each believing them to have been original with himself), consist of a gold ferule, F, F, made from about No. 29 or 30 plate. Upon one side or two (opposite) sides of the ferule is soldered a thicker strip of plate, about one-eighth of an inch in width. The device, when ready, is set upon the tooth with phosphate of zinc cement, in a sticky consistency. Dr. Guilford suggests that the cement should not only line the band, but fill the space between the plane-piece and the tooth, thus aiding in its support, so that when bitten upon it will not bend out of shape. Its superiority to the others, if it has any, is due to its small size. Fig. 111, illustrating modifications of these devices, shows a stay wire to prevent it from moving.

The hoof-plane, C, consists of a gold thimble, made bevelled at the top for a heading of plate to serve as an inclined plane. This heading may be soldered on, or it may

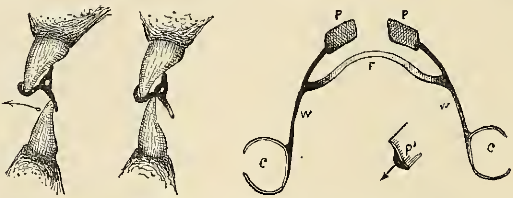


FIG. 112.—Frame Inclined Planes (A).

be a button piece made after the plan known as the Bing method for capping a cavity, and held by a wire projecting into the cement. The other one (sometimes preferable), differs from this one in that the inclined plane is made of a strip of stiff 18 k. gold plate, one end of which is soldered to the ferule, made of a stiff but thin plate of 18 k gold. The object of soldering only one end is to enable the operator to easily change the degree of inclination by rebending it. The supporting of this strip by phosphate of zinc cement is not necessary.

Fig. 112 illustrates one of several modifications of frame inclined planes. These planes (philosophically explained in Vol. 2) consisting of gold plate, P, suitably bent to move the front teeth, are held in place by being soldered to a U-shaped wire, W, which extends back and is fixed by clasps, C, C, or by clamp-bands to the side teeth.[1]

[1] Pub. in "Brooklyn Medical Journal," July, 1888.

CHAPTER XXI.

THE CLAMP-BAND.

LONGITUDINAL SCREW CLAMP-BAND.—SPLICE-BAND.—EXTENSION SWIVEL-BAND.—TRANSVERSE-SCREW CLAMP-BANDS.—FERULES.—EARS.—GUM-GUARD RINGS.

PROBABLY one of the most useful class of instruments ever invented for aiding the operation for correction of irregularities of the teeth is the ring-shaped device for encircling the teeth. This instrument is of two kinds: first, bands that are closed by solder, like ferules; second, bands that are closed by screws resembling those for binding iron rods to smoke-stacks. Suspending for future consideration the former class, we will explain the latter.

Of this kind there are several varieties, but for convenience they are subdivided into two classes denominated longitudinal screw clamp-bands[1] and transverse screw-bands.[2] These instruments serve not only as regulating devices *per se*, but also as anchorages for attachment of other regulating devices. They are also often found useful in other operations in general practice, as, for instance, in filling cavities in teeth, they serve as matrices for damming up approximal cavities, and for bands to hold phosphate of zinc cement around loose teeth to steady them during such operations. For the latter purposes, the longitudinal screw-band is preferable to the transverse screw-band. While all of these devices are useful adjuncts for anchoring other devices to the teeth, the only really valuable one as an engine

[1] "Dental Cosmos," January, 1876. [2] "Dental Cosmos," June, 1878.

of force for moving teeth is the longitudinal screw clamp-band, illustrated by A in Fig. 113.

This instrument may be of a size to embrace only one tooth, B and C, or it can be made large enough to include several, A. For the purpose of securing anchorage for other devices, its value has already been only briefly shown, but we shall have occasion to refer to it many times in explaining the construction and application of various kinds of regulating apparatus to be illustrated in this work.

With regard to the matter of priority of invention of the screw clamp-band, I take pleasure in qualifying some remarks made in a previous portion of this work, by stating that for several years I was under the impression that in the application of even a similar device to the teeth for

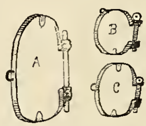


FIG. 113.—Longitudinal Screw Clamp-bands, as made by the Author. (A).

any purpose no one had antedated me; but in November, 1877, about four years after I had written a college thesis concerning its uses, and nearly ten months after its publication in the "Dental Cosmos," (January, 1876), a professional acquaintance showed me a book or journal of an earlier date in which was illustrated a somewhat rude device, evidently intended to serve as an anchorage to something like an elastic rubber ring, and made upon what may be regarded as the same principle as that of the longitudinal screw variety. The method of construction was as follows: A strip of sufficient length to encircle one tooth (I do not remember whether a bicuspid or a molar) was first cut from plate of considerable thickness, after which about one-fourth of an inch of each extremity was bent at nearly right angles to the middle portion, so that when the strip was fitted around the tooth, they were parallel to each other, but stood a short distance apart. Through both extremities of this rigid band holes were drilled, through which passed a very short bolt having a nut on it. The device closely resembled the smoke-stack band for attachment of guy rods.

At that period, although I had made extensive use of clamp-bands, I did not expect that they would be regarded by the profession as especially valuable; consequently the subject made but a slight impression on my mind. Owing to this circumstance, I regret to say that being unable to recall the title of the publication in which the article appeared, I cannot give the name of the writer.

The above instrument as made by me (Fig. 113), which will

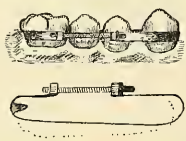


Fig. 114.—Clamp-band as applied to move a Tooth (A).

hereafter, for brevity, be spoken of as the clamp-band, consists of a thin ribbon of platinum or 18 k. gold about one-sixteenth to one-eighth of an inch in width, having a nut soldered to each end, one smooth-bore, the other threaded, both of which are connected by a screw having a square nib or a globular head with a hole through it, this depending upon the fancy of the manufacturer or the requirements of the case. These screws are turned by a watch-key or a lever.

For drawing teeth together, as, for illustration, for moving the cuspid posteriorly to make room for an overcrowded lateral when there is sufficient molar and bicuspid anchorage, there is no instrument simpler, more efficient or more satisfactory than this. (Fig. 114.)

The nuts on these clamp-bands are single, double, or triple, as illustrated in Fig. 115, and located as shown in Fig. 116, or they may be duplicated and located oppositely as shown in Fig. 117.

Splice-band.—To increase the usefulness of the clamp-

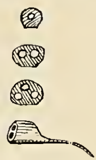


Fig. 115.—Single, Double and Triple Nuts (A).

band, detachable auxiliaries are connected; among the most valuable of these is the plain extension band, and the swivel and screw-band.[1]

Fig. 118 illustrates two varieties of plain splice-bands, both made of wire, two of which, s′, s′, are of gold, rolled

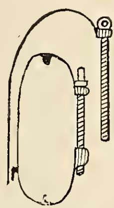


Fig. 116.—Anchor Clamp-band and Splice; edge view (A).

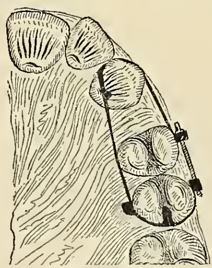


Fig. 117.—Application of the Clamp-band with two Nuts (A).

flat like a ribbon, the other, s″, is round platinum wire (unrolled). This wire is about the size of a small pin.

Fig. 119 shows one modification of a swivel extension-band. These may be made of round or flat (ribbon) wire. The screw end is attached by entering a nut on the inside of the clamp-band, substantially as shown in Fig. 120.

[1] "Dental Cosmos," March, 1878.

To permit easy attachment of the other end of the extension-band, there is made a loop or a hole to catch it upon some part of the clamp-band. This extremity may be bent at right angles to catch over the longitudinal screw, as

FIG. 118.—Extension or Splice-band (A).

FIG. 119.—Swivel Extension-band and Screw (A).

shown applied in Fig. 120, or it may be made straight to be caught on a hook soldered to some appropriate place on the clamp-band, substantially as shown in a side view in the same figure. The lingual nut is not shown.

Application in Practice.—To illustrate the application of the clamp-band and these latter-mentioned forms of splice, let us assume that, in order to make room for an overcrowded cuspid or first bicuspid, a second bicuspid should

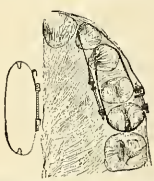


FIG. 120.—Application of the Swivel Extension-band (A).

be extracted. The first step would be to place the clamp-band around the first bicuspid and one or two molars, after which it is tightened by turning the bolt with a key, as far as is possible without causing pain. This should be repeated, say every night and morning. Having drawn the first bicuspid back against the molar, the splice-band is then caught on a hook soldered on the lingual side of the clamp-band (now converted to an anchor-band, Fig. 116), thence extending forward around the cuspid and bolted to the rear (double or triple) nut on the buccal side of the anchor band, then by a watch-key the cuspid is carried back against the bicuspid.

If the cuspid should be so far outstanding that the band, if drawn in that direction, would tend to turn it further outward, a splice-band acting in the reverse direction by means of a swivel, Fig. 119, should be used. The splice-piece is usually anchored to the buccal side of the clamp-band by being caught on a hook soldered to the band, or held in place by the buccal bolt extending through the end of the splice, which is bent at a right angle, as before described. The splice is then made to extend around the cuspid in the opposite direction, the other end being attached to the lingual nut, on the inside of the clamp-band, by the swivel screw, as shown in Fig. 120. By the gradual turning of this screw the outstanding cuspid is easily drawn in the direction desired. Swivel extensions, however, are seldom requisite to the success of such operations.

How to place the Clamp-band between the Teeth.—When teeth are crowded so closely together that they will not easily separate, sufficiently to permit the clamp-band to be passed up between them, orange-wood wedges forced between the teeth and allowed to remain for a few minutes will generally make the necessary room. Usually, however, the band may be driven between the teeth by placing on its edge a thin piece of steel, and then hammering upon it. I generally use either an old worn-out finishing file, ground square at the ends, or an old excavator hammered flat at one end. Fig. 121 illustrates the edge view, and also top view of the file, and Fig. 122, the flattened excavator that has served me for this purpose for several years. It is not easy to apply these bands without the aid of an assistant. Holding one side of the clamp-band in place with one hand, the other side being held by the assistant, and one end of the file supported by my other hand against the edge of the portion of the band that is to be forced between the teeth, the assistant hammers upon it with a leaden mallet with her other hand, when, unless the teeth are very much crowded and firmly set, the band will easily move to the desired place. Should it be found impossible to get the band between the teeth by any of these methods it may be accomplished by filing or grinding the enamel between the

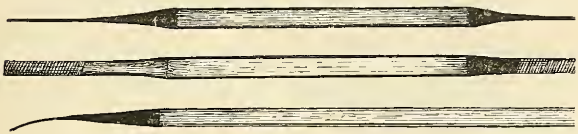


Fig. 121.—File, edge view and top view. Fig. 122.—Excavator.

teeth with a very thin hard rubber corundum wheel; but grinding should not be attempted except as a last resort. The band is so thin, however, requiring but little loss of tissue to make sufficient room (not half the quantity usually cut away to fill approximal cavities), that this procedure ought not to be regarded as very objectionable.

Another way to overcome such difficulties is by using what are called "steel separators," such as are used to separate teeth for the purpose of making room for filling approximal cavities. There are several patterns. (See Figs. 123, 124, and 125.) The author's instruments are devised so as not to interfere with the placing of the clamp-band.

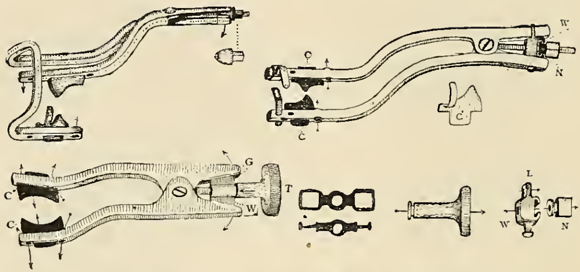


FIG. 123.—Farrar's Clamp-separator, Three Modifications.[1]

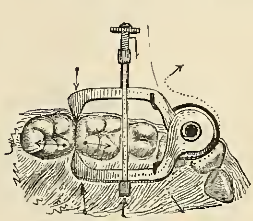


FIG. 124.—Elliott's Separator.

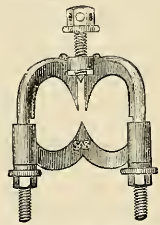


FIG. 125.—Parr's Separator.

Anchor Bands.—Reference has been made to other forms of bands constituting anchor-bands. Although of all the various modifications devised for this purpose none is more valuable for general use than the longitudinal screw clamp-band, the transverse screw varieties are of sufficient importance (for occasional use) to render them worth describing. Of this class, several varieties, which I have previously published in the "Cosmos" (between the years 1877 and 1879), are here reproduced. In Fig. 126 the letters A and B illustrate two modifications of a double-screw variety, made up of three parts, a bow and a bar and two nuts. B illustrates the bow as made entirely of round platinum wire, with screw-cut extremities. These extremities pass through oval holes made in a stiff piece of gold plate and held there with nuts, as shown. A shows a pat-

[1] Invented, 1882.—Patented, but any dentist is permitted to make for his own office use. (Author.)

tern nearly like this in construction, differing only in that the middle portion of the wire bow is hammered flat. This bow can also be made of three parts soldered together, but this is weaker. Flat wire is more useful than the round,

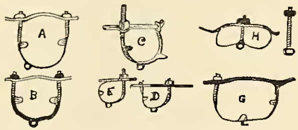


Fig. 126.—Transverse Screw clamp-bands (A). [1]

because more easily placed between the teeth. The remainder of the illustrations show several modifications of single screw anchor-bands, consisting of three parts, a bow, bar, and one or two nuts. The bows may be independent of the bars, as shown by C, D, or united to them by solder, as shown by E. H and G are peculiar varieties. To render these devices serviceable for attaching other devices, rings or hooks are soldered to them at convenient points, substantially as shown.

Ferules.—Ferules are hoops of thin platinum or gold, made to fit around one or more teeth. They are of different widths, varying from one-sixteenth to one-fourth of an

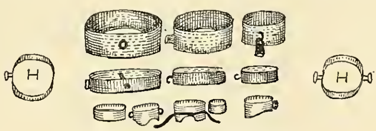


Fig. 127.—Ferules with Attachments.

inch, according to the requirements of the case or fancy of the dentist. For cementing upon the teeth they should not be less than one-eighth of an inch, in order to secure firmness. These ferules are used as anchorage for other things, or to give a shape that will permit of a hold for them without

[1] "Cosmos," Oct., 1877; Mar., June, 1878; Feb., 1879.

slipping off. As means of attachment for other devices, such as wire, strings, jacks, etc., staples or knobs are soldered to them ; but to hold pushing devices in place, holes are made through the side, or sockets are fixed by solder. These sockets may be rigidly attached to the ferule by solder, or be made pliable by interposing a link or a very thin piece of plate (Fig. 127). The uses of ferules are illustrated in various parts of this work. H, H, represents ferules mentioned by C. A. Harris, in his work of 1839 and 1850.

Ears and Lugs for Gum-guards.—When I first used the clamp-band it was found that it would slide down the crown and irritate the gum tissues. To overcome this difficulty several plans were tried, but finally only two were settled upon as being the best. One modification of these adjuncts, denominated "ear" or "lug,"[1] consists of a short flat piece of gold projecting from the side or edge of the band, so that it will extend over and upon the antagonizing surface of the tooth, and rest in some sulcus, substantially as shown in Fig. 117. These ears or lugs vary somewhat in shape and location, as shown in numerous places in this work.

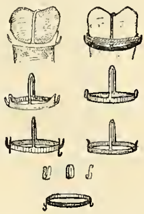
Gum-guard Rings.[2]—One of the best things for preventing regulating apparatus from working down upon the gums is the gum-guard ring· modifications suitable for bicuspids are shown in Fig. 129, and for cuspids in Fig. 130. This device consists of a ring of very thin and narrow gold to fit around the tooth, having a hook or lug on one or two sides to hold the clamp-band string or other regulating apparatus in place. To prevent this guard ring from being itself forced down upon the surrounding gum a slight bail-like strip of thin rolled wire, to rest in the sulcus of bicuspids, is soldered to it, as shown in Fig. 128. Of

[1] "Dental Cosmos," January, 1876, and March, 1878.

[2] "Dental Cosmos," July, 1881.

course, in order to obtain firmness, the ring should fit the tooth, but not too tightly.

This ring may sometimes with advantage be set on the tooth with phosphate of zinc, but no narrow ring will remain thus fixed as firmly as a broader one. In constructing gum-guard rings it is important that the bands should



Figs. 128, 129, 130.—Gum-guard Rings (A).

be made of rolled gold wire, because this material is stronger than plate, which, for this purpose, is so weak as to be worthless; the lugs also should be made non-irritating by having the corners rounded and smooth. To obtain the greatest benefit to be derived from these guard-rings the dentist should always have a variety of sizes on hand.[1]

[1] When I devised these gum guard-rings, I believed that similar mechanisms had not previously been known; but, later, I found that Maury

Gum Guard-Hooks (From Maury, 1828).

(who wrote in 1828) had illustrated a set of hooks for the same purpose. (See accompanying figure.) My guard-rings, therefore, though improvements, must be viewed as modifications of these, here represented.

CHAPTER XXII.

WEDGES.

RUBBER.—CORK.—COTTON.—WOOD.—SCREW-WEDGES.—JACKS.

WEDGES which are sometimes used in regulating teeth, are occasionally serviceable if used alone, but their principal value is as adjuncts to other apparatus. Of all materials used for wedges to separate teeth probably there is none more frequently employed and none more painful to wear than elastic rubber. This material, so valuable in

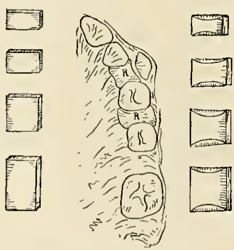


FIG. 131.—Rubber wedges.

many other branches of our profession, should undoubtedly be regarded with less favor for separating teeth than it has been in the past. I do not mean that it ought to be entirely dispensed with, for in some cases it is valuable; but to make use of elastic rubber as a wedge when it causes intolerable pain, especially when other equally effective materials are at hand which cause less inconvenience to the patient, is, in my opinion, wrong. The manner of wedging by means of rubber is to stretch a long narrow strip, until it is reduced in thickness to a mere ribbon, and draw it between the teeth; after which it is allowed to contract, and then the ends are cut off, leaving only a short block between the teeth. Fig. 131 illustrates some of the various shapes of rubber blocks after being thus cut.

Cork.—Wedges for wide gaps made of fine grained cork, compact but not hard, are sometimes better than rubber. In shaping these wedges, it is necessary to make them considerably larger than the gaps in which they are to be placed, and of a form that will dovetail between the teeth. This material is not often used.

FIG. 132.—Cork wedges.

Cotton.—One of the oldest and most convenient, though filthy, methods of separating teeth is by forcing a wad of tightly rolled cotton between them. This swells slightly, and causes the tooth to move with much less pain than by elastic rubber. Cotton, in order to maintain cleanliness, should be often changed. If, when one wad is removed, a larger wad is substituted, the teeth may be moved a considerable distance in some cases. Cotton in the form of tape is sometimes preferable to loose cotton.

Wood.—Of the different materials for wedging, probably there is not one better adapted for the purpose, or any that will cause less pain, than wood, in degrees of hardness ranging from pine to orange. Wooden wedges swell slowly upon being moistened by the saliva, and act so gently upon the teeth that they cause little pain in moving, and sometimes none. When one wedge or block has expended its usefulness, it should be changed for a new and larger wedge. Fig. 133 illustrates some of the various shapes and sizes of wedges as generally used.

The opinions of operators differ as to the kind of wood best adapted for this purpose, but this is not a material

Fig. 133.—Wooden wedges.

point. For wide gaps I generally use some soft wood, as, for instance, white pine, and for very narrow gaps a harder kind, such as orange wood.

The possibilities of wooden wedges are great. By their means even considerable portions of the arch may be regulated in rare cases. As wood swells transversely to its grain, wedges should be fashioned so that when they are placed between the teeth the grain will correspond with the transverse diameter of the alveolar ridge. As the value of wood will be shown in explaining various operations in Vol. 2, the inquirer is referred to it.

Metallic Wedges.—Fig. 134 illustrates a small wedge device for forcing teeth, having long crowns, a short distance apart. This may be applied, for instance, where a bicuspid

Fig. 134.—Metallic wedges in detail (A).

needs to be forced along to fill the space left by an extracted tooth. These instruments, which should be made in different sizes to suit gaps of different width, are composed of parts as follows: a small screw, *e*, wedges, *w*, gum-guard lugs, *d*.

Fig. 135 illustrates the application of these wedges to force the left bicuspid forward against the lateral to make it fill the place of a lost cuspid.[1]

To tighten this instrument upon the teeth, the screw is

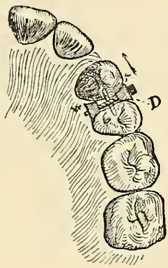


FIG. 135.—Appearance when applied (A).

turned by a key. By the screw passing through the smooth-bored wedge-shaped nut, D, into another, W, (which is screw-cut), the wedges are made to approach each other.

Fig. 136 illustrates two views, G and g', of a modification of the above device, which is sometimes useful where teeth are nearly in contact. The lingual wedge, w, is soldered to

FIG. 136.—Modification of the above Metallic Wedges in detail (A).

one end of a very thin strip of rolled-gold wire, having a screw, e, on the other end. Over this screw slides loosely a smooth-bored wedge-shaped angular nut, which when tightened upon by a threaded nut draws the wedges be-

[1] "Dental Cosmos," March, 1878, and July, 1881.

tween the teeth. The thin ribbon covers one side of the lingual wedge.

To prevent the devices from slipping down the crowns of the teeth upon the gum, a piece of flat wire, *d*, is soldered to the thin ribbon, which, extending out over the antagonizing surfaces of the teeth, is bent to rest in the sulci. This is not always to be secured by wooden wedges.

Fig. 137 represents another form of metallic separator that is suitable for moving teeth a greater distance. This also is made to act on the principle of the wedge. The heads, S, S, are so shaped that when they approach each other by means of the screw, P, they impinge like double wedges upon the teeth, T, T, driving them apart in the direction indicated by arrows. These devices are useful for

Fig. 137.

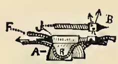


Fig. 138.

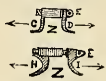


Fig. 139.

Figs. 137, 138 and 139.—Jack wedges for Separating Teeth (A).

cases requiring great power in a small compass. The accompanying figures, 138 and 139, illustrate modifications of a device for this purpose, acting upon the principle of the screw-jack.

In Fig. 138, J shows a screw for a jack, about one-quarter of an inch in length. Such a jack is soldered to a small piece of gold plate, R, curved to fit saddle-like upon the gum between the teeth to be forced apart. This saddle is then vulcanized to hard rubber shaped to rest on the gums on either side of the teeth. The extremities of the jack are intended to impinge against the necks of the teeth nearly on the line of the gum. To steady the instrument in position, where the rubber plate is not necessary, a piece of wire, F, is soldered on each side of the saddle, R, of the jack-screw. These extend partially around and rest on either side of the adjacent teeth.

In Fig. 139, Z, Z, represent different but more useful varieties of jacks. The jaws, C and H, are made stationary by solder to the barrel of the jack, or are made in one piece, while those of D and I are movable and play upon the neck of the screws, E, E. The locking of these jaws upon the screws so that they will not play along the latter, is accomplished by collar-nuts soldered to the screw, leaving just room enough for the screw, E, to turn easily within the jaw, I. This lock-nut is indicated in black in the lower figure. These instruments are delicate yet strong, and are easily applied and operated. Like those previously described, which are more useful in the case of long teeth than of short ones, they are somewhat complicated, and are therefore only recommended to those dentists who take pleasure in exercising mechanical skill. To prevent the instrument from slipping down upon the gum, the jaws have ear-lugs (not shown in the figure), to rest in the sulci of the teeth.[1]

---

[1] To prevent an impression that I manufacture regulating apparatus for sale, I will state that, at no time, have I done so ; nor have I, in any way, been financially interested with others in so doing.

There has, of late, been an attempt made by a few persons to place on the market devices of their own manufacture. Some of these I have illustrated in this work ; but, to mention them in the form of advertisements would, I think, be inappropriate. The best place to obtain regulating devices is in the dentist's own laboratory. On this subject my views have been, heretofore, fully expressed. (See pages 207–208 of present volume.)

CHAPTER XXIII.

SEPARATORS.—(*Continued.*)

METALLIC SEPARATORS.—SPIDER SEPARATOR.—H SEPARATOR.—TRIPLEX-ACTING DEVICE.

IN the last chapter various kinds of wedge and jack devices for separating teeth were illustrated and explained. We will now proceed to another class of machines used for the same purpose. I refer to devices made of spring metal. An old device, that is sometimes effective, is a piece of plate so bent as to maintain temporary force against the teeth. Such devices are variously constructed, and

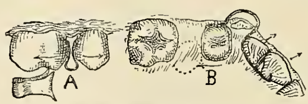


FIG. 140.—Spring Separators.

range in size from less than that of the smallest tooth to that of the roof of the mouth. Some of the smaller of these may be made to act intermittently by using rigid metal, or continuously by using elastic metal. A, B, Fig. 140. A piece of thick plate, an eighth of an inch or more in width, filed fish-tail shape at the extremities and bent somewhat in the form of the letter U, and sprung between the teeth (see A[1]), can, by being opened wider and wider from day to day, be made to separate them sufficiently for the reception of an artificial tooth.

---

[1] Published in "Dental Cosmos," p. 606, Nov., 1879.

By the use of longer strips of spring-plate, constructed on the same principle, extending across the mouth, as illustrated by s, Fig. 141, teeth erupted in the posterior position may sometimes be successfully forced outward into line. But this is a rickety and painful device, and should be

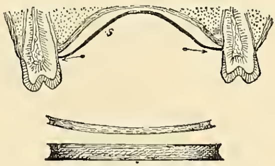


FIG. 141.—Transpalatine Flat Spring.

abandoned. The old-fashioned spring-jacks made of wire, to extend like an arch across the mouth, and having long crutch-like extremities, are modifications of this device. As such jacks belong more appropriately to another chapter, they will not now be further explained. (Page 261.)

When an immovable wedging device is required, it may be made of wire fastened to plates, or soldered to a clamp-band screwed firmly to adjacent teeth or to a ferule set upon such teeth, but as these also are treated of in other sections of the work, they will not be further considered here.

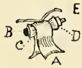


FIG. 142.—Spider separator enlarged. (A).

FIG. 143.—Detail.

FIG. 144.—Detail.

Spider Separator.—Among the devices for moving bicuspid teeth backward, when it does not seem prudent to use the posterior teeth for anchorage, is the "spider" separator, so-called because in shape it somewhat resembles that insect. This device, although difficult to make, and when made only occasionally applicable, appears to be sufficiently novel to entitle it to mention.

Fig. 142 is a perspective view of this curious and very small device, as it appears entire, and Figs. 143 and 144 the same in detail. Figs. 145, 146, and 147 show its application to the teeth.

The separator consists of two spreading jaws A A (Fig. 142), which may be in one piece (as in 143), or in two pieces joined together by a hinge (as in 144); a bolt, B; two wedges, C C; nut, D; and retaining wire, E.

The jaws, A (Fig. 143), may be made of hard gold or some other non-oxydizable metal, bent to fit beneath the

FIG. 145.

FIG. 146.

FIG. 147.

FIGS. 145, 146 and 147.—Different Views showing the Appearance of the Spider Separator as applied to the Teeth (A).

bulges of the approximal sides of the teeth. The wedges consist of two conical pieces of gold, C C, having a hole through each for the bolt, B, to pass through, which, when made tight by the nut, D, causes them to approach each other. Through the arch between the upper part of the two jaws, A A, is placed this screw, having a wedge on each extremity, as shown in Fig. 147, which, when tightened by the nut, D, (Fig. 142) draws the wedges, C C, toward each other, and forces apart the jaws, A A, which in turn move the teeth apart. To prevent the jaws from working down under the gum, a piece of flat 18 k. gold wire, E, is soldered to the upper portion of the arch of the jaw-pieces, A A, as shown. The wire is bent to fit in the sulci of the adjacent teeth. This device, which is only applicable to long crowns, must be made very compact and smooth, or it will irritate the tissues.

Fig. 146 illustrates an edge view of the jaws, A A, of the device, as they appear when applied between two teeth, before the wedge is added.

Fig. 145 is a side view of the machine, and Fig. 147 an end view of the same, as it appears when adjusted upon the teeth and at work.

The H *Separator.*—Among the separators that may be regarded as valuable is one which I have denominated the H separator, because of its resemblance in shape to that letter. To render this thing more useful several modifications have been devised. The original is illustrated in Fig. 148, as

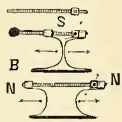


FIG. 148.—H separating Devices (A).

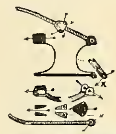


FIG. 149.—Modification (A).

closed, ready to be placed between the teeth, and also as it appears when it is opened.[1] The device, although its action causes equal force in opposite directions, is, in practice, generally intended to move only one tooth at a time. This is accomplished by so placing the instrument that several teeth serve as anchorage on one side to one tooth on the other. Fig. 149 shows the breastpin modification.

To illustrate the operation of this separator, suppose a first molar has been extracted, and there is not left sufficient molar anchorage to draw upon to move anterior teeth back. Instead of using this weak anchorage, the second bicuspid, if very close to the first bicuspid, is started back toward the second molar by a wooden wedge forced between them. After a sufficient space has been made, the H separator is

[1] "Dental Cosmos," March, 1886.

inserted, and made to act on the tooth by means of the screw, S, which, when turned on its pivotal extremity in the nut at the right, forces the ribbons between the screw, S, and the stiff strip of plate, B, in opposite directions, as indicated by arrows.

The H separator, which also serves well the purpose of a matrix, is made as follows: To the ends of a narrow strip of stiff plate, B, about five-eighths of an inch in length, are soldered, or caught by rings (shown by × in Fig. 149), narrow ribbons of gold or platinum, thin as writing paper. To the other extremities of these ribbons are soldered two nuts,

FIG. 150.

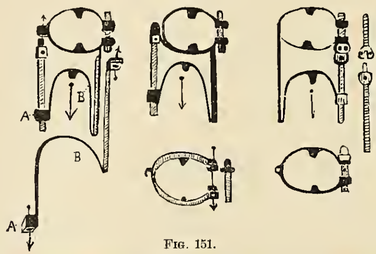


FIG. 151.

FIGS. 150, 151.—Different Modifications of the Anchor-band and H separator combined (A).[1]

N, as shown, between which plays a screw, S, one end of which is spindle-shaped. Placing the device in position, the nuts are driven apart by the bolt, which moves the second bicuspid back to the molar, when this tooth is clamped to the molar and held there; the H separator is then removed and reset forward between the next bicuspid and the tooth anterior to it to force this bicuspid back against the second bicuspid, to be in turn bound to the other two teeth by a splice-band (Fig. 118). The only difficulty with this separator is in making it firm. Stability may be obtained, however, by soldering the H to an anchor clamp-band bound to other teeth. It may also be fastened to a ferule

[1] "Dental Cosmos," March, 1886.

fixed on one of the teeth, or by means of a plate fitted to ride on the gums. The plate may be small or may be large enough to cover the entire roof of the mouth.

Fig. 150 illustrates several modifications of the H separator as they appear attached to clamp-bands, and Fig. 151 shows the bands independent of the separator. The most important use to which H separators may be put is for moving teeth back where there are no molars.

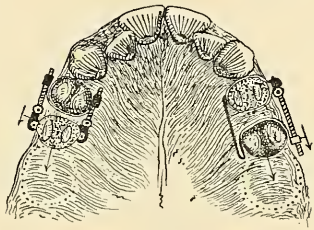


FIG. 152.—Ferule and H separators. Appearance as applied (A).[1]

In Fig. 152 are illustrated two modifications of the H spreader attached to ferules set on teeth with phosphate of zinc. Figs. 153, 154, and 156 show different views of such an apparatus independent of the teeth, and Figs. 155 and 157 the same in detail. Fig. 157 is a top view, showing the hinges between the ferule F′ and the sockets, D, D, for the screws.

FIG. 153. FIG. 154.

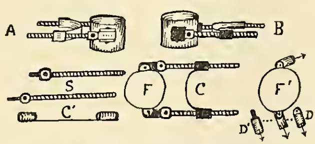


FIG. 155. FIG. 156. FIG. 157.

FIGS. 153—157.—The Ferule H separator in detail (A).[1]

This instrument, though powerful in operations for forc-

[1] "Dental Cosmos," March, 1886.

ing teeth posteriorly, is somewhat rickety at the joints between it and the ferule. This defect can in a measure be remedied by a finger soldered to the ferule to extend alongside the screw. This finger is illustrated in Fig. 158.

FIG. 158 (A).[1]

Fig. 159 shows one plan of using the H separator in combination with a hard-rubber plate for the purpose of securing anchorage, a plan that permits it to be easily removed and readjusted, and one which is also valuable in cases where without the plate there is danger of dislodgment.

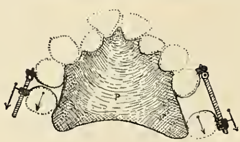


FIG. 159.—H Separator Anchored to Plate (A).

Screw-Triplex.—This instrument is so called, because constructed to exert force in three different directions at the same time by turning one screw. I invented the triplex in several forms, two are shown in Fig. 160. A (the best) is made by

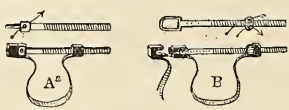


FIG. 160.—Triplex-acting Devices (A).[2]

soldering a nut to each end of a thin strip of rolled wire, not much exceeding one-sixteenth of an inch in width. One nut is threaded, the other smooth-bore ; in the latter plays the

[1] "Dental Cosmos," March, 1886.
[2] "Dental Cosmos," Nov., 1884.

spindle-shaped point of the screw. To operate this device the ribbon is passed round the instanding tooth, leaving the nuts to bear upon the outside of the adjacent teeth; between them is fixed the screw, which, when turned, forces the nuts apart and with them the adjacent teeth, and at the same time draws the instanding tooth up between them. The independent screw in the figure shows its form.

Though sometimes causing trouble by slipping, I do not know of any small device more reliable and satisfactory than this. Generally, however, slipping may be prevented by a gold or platinum ferule set upon the tooth with cement, or

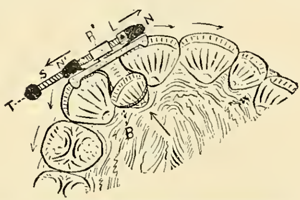


FIG. 161.—Triplex-acting Screw-loop, enlarged (A).

by hooks made of plate projecting from the screw, over the cutting edges (see Y, Fig. 162), or by being connected with an anchor-band. The B form (Fig. 160) is less valuable.

Sometimes the triplex is serviceable for forcing an outstanding tooth into line, but, unless the tooth is nearly cylindrical, like a bicuspid, or is made so by a ferule set upon it, the band is very liable to slip off. To move a tooth with a screw machine is easy if it is made so as to hold on; but with the unskillful, "there's the rub."

Fig. 161 illustrates the device as applied to regulate a lateral incisor. To reiterate, in detail, this triplex is made and operated thus:

A screw, S, with a non-irritating thimble, T, on the terminal end, the opposite end being set in a smooth-bored socket-nut, N, is made to turn by means of a lever-key, used in the bulb, L, so that when the threaded nut, N, moves along the screw, S, toward the thimble, T, it will cause the ribbon-like loop, B, to straighten ; thus it will not only draw upon the instanding lateral incisor in the direction indicated by the arrow, but force the cuspid and central away at the same time in the direction also shown by arrows.

Fig. 162 illustrates separately and collectively several modifications of my triplex-acting instruments. The same letters indicate corresponding parts shown in different views.

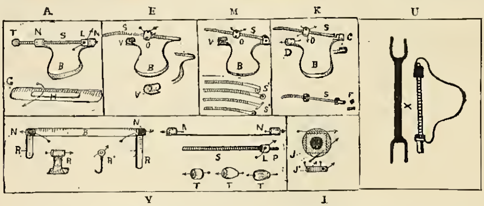


FIG. 162.—Different Modifications of the Triplex-acting Screw-loop (A).

A, shows the triplex device in its best form, using a detachable screw, S, with bulb, L, soldered to it for the key. T is a non-irritating nut; G, bridge.

Y, shows the different parts in detail, with two modifications of retaining attachments to hook upon the edges of the teeth and so prevent the device from slipping upon the gum. One form consists of strips of plate, R, R, soldered to the loop-nuts, N, N; the other, R′, R′, hangs loosely from the screw, S. These, however, are seldom necessary.

E, is a breastpin form in which the screw, S, is fixed by solder to one end of the ribbon, B, and is operated by a loose nut, O, by means of a lever-key inserted in holes in its side (see arrow). This presses against the flat hook, V, on the other end of the ribbon.

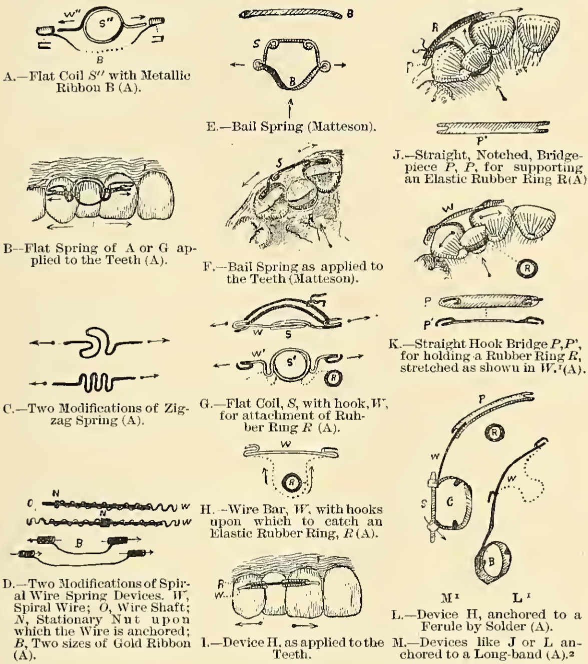
M, is another modification of the breastpin form ; the end of the screw, S, plays on a rivet, between two ears (passing through them). S′, S′, show different forms of the hinge extremity of the screw.

K, is a form having a detachable screw, S, with one extremity square or flat (see F) to rest in a correspondingly shaped cup-nut, C, while the other extremity rests in a smooth-bored nut, D.

The three last-mentioned forms are operated by circular nuts because they are less irritating, and although they are larger they require no more room to turn in than square nuts (see the two forms in J). The arrows indicate position of holes for lever-key.

U is a triplex, consisting of a clamp-band and a double-fork bridge-piece. This acts by drawing the nuts toward each other, over the bridge.

In cases where the side teeth are sufficiently far apart, and it is desirable to hold them in a fixed position while drawing into line the outstanding tooth, a collar plate, with a hole for the loop to play in may be used; but in most cases this also is superfluous. For explanations as



A.—Flat Coil S'' with Metallic Ribbon B (A).

B—Flat Spring of A or G applied to the Teeth (A).

C.—Two Modifications of Zigzag Spring (A).

D.—Two Modifications of Spiral Wire Spring Devices. *W*, Spiral Wire; *O*, Wire Shaft; *N*, Stationary Nut upon which the Wire is anchored; *B*, Two sizes of Gold Ribbon (A).

E.—Bail Spring (Matteson).

F.—Bail Spring as applied to the Teeth (Matteson).

G.—Flat Coil, *S*, with hook, *W*, for attachment of Rubber Ring *R* (A).

H.—Wire Bar, *W*, with hooks upon which to catch an Elastic Rubber Ring, *R* (A).

I.—Device H, as applied to the Teeth.

J.—Straight, Notched, Bridge-piece *P*, *P*, for supporting an Elastic Rubber Ring R (A).

K.—Straight Hook Bridge *P*, *P'*, for holding a Rubber Ring *R*, stretched as shown in *W*.[1] (A).

L.—Device H, anchored to a Ferule by Solder (A).

M.—Devices like J or L anchored to a Long-band (A).[2]

FIG. 163.—Triplex Acting Devices operated by Elastic Materials.

to how other difficulties may be obviated the reader is referred to Chapters on Correction of Incisors, in Vol. 2.

Elastic Triplex.—The triple movement of the teeth obtained by intermittent force from the above-mentioned

[1] Lecture, Feb. 27, 1888. Brooklyn Medical Journal, July, 1888.

[2] "Cosmos," March, 1886.

device can be made by the application of continued force derived from a modification of the device, which substitutes the screw by piano-wire (about No. 16), or elastic rubber. If wire is used, it is important to construct the spring so that it will not by clumsiness irritate the lips. To do this is not easy. Fig. 163 illustrates several modifications of such devices. A shows one form of spring which is intended to lie flat on the teeth, and if properly made this will not be much more clumsy than the screw plan. As may be seen in the figure, the extremities of the wire constituting the spring extend in opposite directions. The object of this is to furnish a means of attachment for the ends of the ribbon. When ready to apply the device to teeth the wire portion is sprung shorter, then the caps which are soldered to the extremities of the gold ribbon are caught on the ends, after which the entire device is forced in place upon the teeth and left there to do its work. B shows the application of this device to the teeth. As will be seen, this coil has but two turns, and, by lying flat upon the teeth, it is not as much in the way as it would be if it stood out from them.

C shows other forms of springs for this purpose, but whatever advantages there are in the spring-wire plan, their clumsiness is no less than that in the screw plan; and as the degree of efficacy is somewhat uncertain, these devices cannot be as valuable as the triplex-screw, because not so reliable.

D shows a plan of causing force, by the use of spiral springs W playing on a piece of wire. This force can be obtained by one or by two spirals, acting on the ribbon B.

Dr. Matteson in the "Cosmos" of February, 1888, illustrated a plan of spring, that in some cases will probably be found useful. This spring, which is illustrated by E, is made by bending a piece of piano-wire so as to have two spring coils situated a short distance apart, and located, as it were, at two corners of three sides of a square, as shown.

Upon the extremities of this wire, which are bent in the form of a coiled hook, are caught the extremities of the gold or platinum ribbon, B, by a hole in each of the extremities. The precaution to be exercised in the use of this device is the same as with the device previously described. To avoid irritation of the soft tissues, Dr. Matteson suggests the covering of irritating portions of the device with gutta-percha. In place of the gold ribbon, gilling-twine is mentioned as occasionally useful. The application of this device is shown in F.

G illustrates a modification of that shown by A, differing from that of A only in substituting for the platinum ribbon a string or an elastic rubber ring, R, cut from tubing. Of course, when elastic rubber is used, the spring in the wire seems unnecessary. It is mentioned to show that the wire part made for a string may be also used for rubber; but when the metallic portion is to be made especially for rubber it is only necessary to use a nearly straight piece, having hooks on the extremities upon which to catch the rubber ring, as shown in detail in H, and as applied to the teeth in I. The difficulty found in the use of wire for this purpose, unless fixed to the teeth, is its liability to slip. To meet this difficulty, in a measure, one end of the wire may be soldered to a ferule or to a wire extending to one, as shown in L.

J and K illustrate the simplest and perhaps the best plans of making and using elastic rubber instead of a screw, S, in these triplex-acting devices. It is merely a strip of plate, P′, about one inch in length, having a notch in each end as shown in the lower part of figure J, over which is stretched an elastic rubber ring, which extends the entire length of the strip and around the instanding tooth. If hooks are used the rubber is caught as shown in K. When the shape or position of the tooth will not afford sufficient firmness to these devices, they also may be held in place by soldering them to wire connected with ring-bands as shown in L, M. Sometimes, however, even the other end of the strip needs to be tied to a tooth to steady it.

CHAPTER XXIV.

SPRING-JACKS.

ZIGZAG WIRE-JACKS.—SPRING-JACKS ANCHORED TO CLAMP-BAND, ETC.

ATTENTION is now directed to a class of regulating devices, denominated jacks, some of which are only adapted for moving teeth that are so inclined toward each other that devices depending upon impingement alone for their retention are sufficient, while others are suitable under all circumstances. The devices are anchored in various ways, some by making use of the elasticity of metal, others by the use of the screw. Beginning with the simpler

FIG. 164.—Spring-jack (Westcott).

forms, we will afterward proceed to those which are more complicated and more interesting.

Westcott's.—Fig. 164 represents a form of spring-jack described in an article published by Dr. A. Westcott in 1859.[1] The extremities of this device are made like clasps, such as are used to fix partial dentures to the natural teeth. These clasps are soldered to a curved cross-bar of silver wire (No.

---

[1] "Dental Cosmos."

17), the object of the curve being to place it out of the way of the tongue as much as possible by shaping it so as to conform to the roof of the mouth. To lengthen this jack, it was removed and the extremities pulled further apart.

FIG. 165.—Spring-jointed jack (Westcott).

Dr. Westcott at the same time described a similar device, illustrated in Fig 165.

This only differs from the other in a single point. Instead of soldering the clasps to the ends of the connecting rod, they are hinged to it by means of rivets. This is done to prevent rigidity and to permit the clasps to adjust themselves to the teeth after the cross-bar of the jack has been altered in shape, or after the positions of the teeth have changed. Both of these devices are imperfect, when viewed as scientific means to ends, for they easily become dislodged by the action of the tongue in swallowing food.

FIG. 166.—Spring-jack (Magitot).

Magitot's.—In his work on "Dental Anomalies," 1867, Magitot of Paris describes a device constructed in a manner similar to that made by Dr. Westcott (Fig. 164), but more scientific, because, by embracing a greater number of teeth, the transpalatine spring is not so liable to become dislodged by the tongue. Fig. 166 illustrates this broadly based spring-jack.

Zigzag wire Spring-jacks.—Fig. 167 illustrates a set of three modifications of very simple and effective spring-jacks, which I denominate zigzag jacks. These I devised subsequently to the introduction of the spring-jack of Dr. Westcott. A is for use between side teeth. B, C, transpalatine.

The extremities of these jacks are made of clasp metal, or rolled wire, which is soldered to the ends of a piece of gold wire in size varying from No. 16 to No. 19, the wire being bent zigzag, as shown in the figures. To extend these jacks,

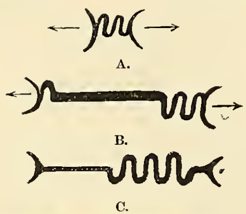


FIG. 167.—Zigzag Spring-jacks (A).

all that is necessary is to pull out the curvatures to the degree necessary. These jacks, although not so firm as devices that will be explained hereafter, are, by extending straight across the mouth, not so liable to become dislodged as the previously described forms, which curve to fit the roof of the mouth. Fig. 168 shows the form and application of another modification of this kind of spring-jack. It consists of a straight piece of wire bent zigzag at one end, soldered to a clasp to fit the curvature of a tooth, the other end being spindle-pointed for the purpose of entering a pit in a tooth opposite, as shown. The device is simple and easily made, and in some cases is very useful. The principal objection to all such jacks being that they are liable to be disturbed by the tongue. To guard against their being swallowed in case of falling from their position, they should be tied by a string to some tooth. Pits should never be made in the incisor teeth, because they are too thin, but may be made without injury in cuspids that are large. Of course they should be filled afterward. The accident of being

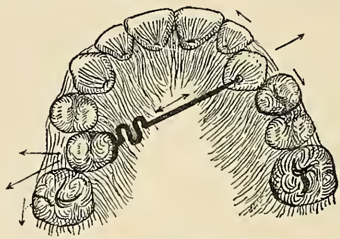


FIG. 168.--Spring-jack as applied (A).

swallowed is liable to occur with any jack that is not fixed to a ferule, plate, or screw clamp-band.

Fig. 169 illustrates a double spring-jack of the zigzag variety. In detail, the steps in the construction of this device are as follows: first, bend each of two wires into the form of a W, after which solder to each end of each wire a

FIG. 169.—Double-zigzag Spring-jack (A).

short clasp to fit the bicuspid teeth. This accomplished, another wire serving as a body-piece is bent something like the form of a letter S, and soldered to the middle point of each W-wire; all of which is shown in the diagram.

To apply this s and w zigzag spring-jack in practice, it is drawn out, if the case requires it, or if too long it is cramped short enough to be sprung between the opposite bicuspid teeth, which, by the pressure thus brought to bear upon them, are easily moved apart. This device in silver or gold is simple to make, easy to apply, and effective in its work. The jack may be made to extend transversely from one side of the dental arch to the other, as here shown, or it may be bent to act diagonally, or may be curved upward to conform to the shape of the roof of the mouth. In practice it is found that the same criticism applies to this device, if so

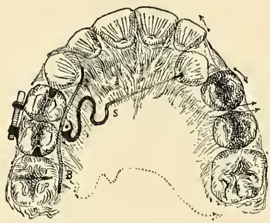


Fig. 170.—Anchored Spring-jack (A).

curved, as to Dr. Westcott's, namely, that while it interferes less with the tongue, the tongue interferes with it, rendering it liable to become more easily dislodged than if made straight, on account of the curvature acting like a lever on the extremities of the jack ; or similarly to a crank between two grindstones.

Spring-Jack anchored to Clamp-band.—Fig. 170 illustrates a plan of attachment that insures firmer anchorage than does any form of clasp. This consists in combining a spring-jack with a screw clamp-band. It is constructed as follows: a screw clamp-band is first made, after which there is soldered to its lingual side a bar to rest along the surface of adjacent teeth and bear upon them, for the purpose of increasing the anchorage. To the middle point of this bar, or of the anchor-band if the bar is not needed, is soldered a ring, or, better, two ears, between which is loosely riveted a flattened extremity of a piece of spring wire, the

FIG. 171.—Anchor-band (A).

other end of which is pointed to enter a pit in some opposite tooth that is to be moved, here shown as a cuspid. The anchor ring is shown independently in Fig. 171. (See Fig. 173 *b*.)

To operate this device the spring-jack is lengthened by the use of round-beaked forceps applied to the curvatures of the wire in such a way as to straighten them. This mechanism is somewhat difficult to construct, but once made

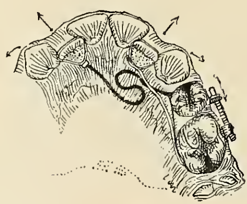


FIG. 172.—Counteracting Springs (A).

it is not only applicable to many cases, by suitable changes in the form of the spring, but is also convenient at all times.

Fig. 172 shows the form and application of a double-acting device; one part acting like a jack, the other like a side spring; both are soldered to a screw clamp-band, which serves as anchorage. The device, as here shown, is intended for moving the opposite laterals into line by acting from only one side of the mouth, the force being given somewhat in opposing directions, as indicated by arrows.

This device is constructed as follows: To the anterior portion of the anchor-band, which is made to fit around the left second bicuspid and first molar, is soldered a zigzag-shaped spring wire, spindle-pointed at the opposite end, to rest in a hole in a ferule cemented upon the right lateral. To the posterior portion of the anchor-band is soldered an-

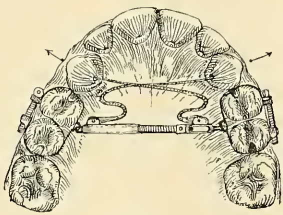


FIG. 173a.—Double Spring-jack (A).

other, and a straight piece of spring wire extending anteriorly, to bear upon the feruled left lateral, as shown.

As the forces of these springs act in different directions, they do not materially disturb the anchor teeth. The increase of pressure is made by bending the springs more and more from time to time. This device is rather troublesome to wear, but once made and properly applied it is successful.

Fig. 173^a illustrates a rather awkward spring device for forcing into line stubborn upper cuspids standing in the posterior position. These springs are anchored to a cross-screw-jack linked to anchor bands around the side teeth.

This device, although sometimes useful, is illustrated more to show how appliances may be improvised at short notice from old odds and ends of others that may happen to be on hand, especially where it is desirable to fix the springs so that they will not be dislodged by the tongue. Of course the form of the springs may be varied to suit the requirements of different cases.

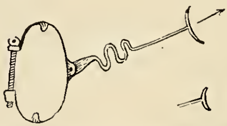


FIG. 173 *b*.—Spring wire-jack with crutch extremity. (A).

The three last described devices are spindle-pointed, but this is not necessary in all cases ; where the teeth to be moved are of proper shape to hold a crutch extremity, as illustrated in Fig. 173*b* such an extremity should be used in in preference to a spindle-point, especially is this so if the spindle point necessitates a pit in the tooth.

CHAPTER XXV.

SCREW-JACKS FOR PUSHING.

FERULE-JACKS.—NUT-JACKS.—DOUBLE SPINDLE-JACKS.—YOKE-JACKS.

A SCREW-JACK or jack-screw, as often wrongly called, differs from a spring-jack in the fact that the force is derived from the use of a screw instead of a spring. A screw-jack is an instrument capable of exerting great force, and was invented to raise heavy weights, such as houses and monumental works. The lexicographical definition of a screw-jack is "a strong screw for lifting or supporting a heavy weight; it rests by means of a large nut upon a hollow-threaded pedestal base and is raised or lowered by turning the screw." This definition should be remembered by the reader as he goes on, in order to see how the character of the original screw-jack gradually changes and continues to change until all features of the true screw-jack will disappear ; and yet a dividing line to show where the screw-jack leaves off and its successors begin could at best be only arbitrarily given.

There are two varieties of dental push-jacks, the fish-tail or crutch and the spindle-ended. Of each of these there are several modifications. Fig. 174 illustrates three modifications of steel screw-jacks invented by Dr. W. H. Dwinelle, which are believed to be the first push-jacks that were made for regulating teeth. Nos. 1 and 2 show two views of two forms of one modification. They differ only in the shape of the frame, No. 1 being straight, while that in No. 2 is bent. In fact, the No. 2 is No. 1 bent. No. 3 is a double spindle-jack. These views are drawn from the origi-

Fig. 174.—Screw-jacks (Dwinelle).

nal instruments, placed in my hands for this purpose by Dr. Dwinelle.[1]

Fig. 175 illustrates a form of screw-jack published in 1860 by Dr. E. H. Angell, several years after Dr. Dwinelle devised his jacks. This consists of a large wire threaded reversely at the opposite extremities, and a body between


Fig. 175.—Screw-jack (Angell).

them made square to fit a wrench. Each of these screw-cut extremities is then screwed into a piece of threaded tubing, having crutch-like end pieces suitable to fit the curvature of the teeth.

Figs. 176 and 177, represent two patterns of screw-jacks, which were placed upon the market a few years ago by


Figs. 176 and 177.—Jacks sold in the market in 1887.

McCollom and Longstreet, and are the only kinds in market at this time. As will be seen, the one shown in Fig. 176 closely resembles Dr. Angell's device, while the one in Fig. 177 resembles that of Dr. Dwinelle (Fig. 174). Screw-jacks

[1] See chapters in Part II. on the history of the screw for regulating teeth.

constructed as shown in Figs. 174 and 177 have but one screw, and are more scientific than those constructed with reverse screws, such as shown by Figs. 175 and 176, not only because they are simpler, but they are more easily operated. This is owing to the fact that the inclined plane or wedge principle in the former is only half in degree,

Fig. 178.—Modification of Dwinelle jack.

hence requiring half the force to operate the instrument, which makes it much less liable to turn out of place and become dislodged.

Fig. 178 illustrates a slight modification of the Dwinelle jack. As will be seen, it consists in broadening the thin extremity, so as to secure increased grip upon the tooth.

Finding that the screw-jacks purchasable at the shops were too large, clumsy, and illy adapted for my purpose, I devised several modifications, some of which will now be described, beginning with the cheapest and least efficient, denominated the ferule jack, and going forward to the more expensive and more useful.

Ferule-jack.—The body of this jack is a tube, open at

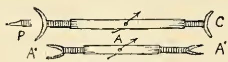


Fig. 179.—Ferule-jacks, No. 1 (A).

both ends, and screw-cut inside. Into the ends of this ferule, A, are then set fish-tail screws of different sizes, P C, Fig. 179. The directions for making sets of these jacks are as follows: Take a long piece of jewelers' "piping," and cut it into pieces of different lengths varying from one-fourth to one inch. The inside of these are then screw-cut the entire length; into one end is then placed a fish-tail screw of the size to fit the threads in the tube; into the other end is placed a fish-tail piece of a smaller jack, which plays loosely in the barrel. The object of the smaller size is to permit rotation of the barrel of the jack while in the mouth.

Fig. 180 illustrates a modification, or rather an alteration, of the device shown in Fig. 179, consisting of a ferule, T, the inside of which is threaded, and in which is substituted a

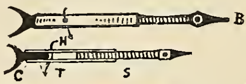


Fig. 180.—Ferule-jacks, No. 2 (A).

spindle-pointed screw, S, in place of a crutch screw. In the other extremity of the ferule plays loosely a smooth crutch-piece, C. As this piece has no thread it is liable to drop out. The only advantage in such a jack over the old-fashioned jacks of the shops (Figs. 176, 177) lies in its delicacy and in being easily improvised with ordinary tools.

An improvement in this is made by simply soldering the loose crutch-piece to the end of the barrel, so that the jack can be operated by one lever placed in the hole in the head of the spindle-screw.

To operate the other jack, place a right-angled lever through a hole somewhere in the middle third of the ferule,

Fig. 181.—Constricted Neck-jack (A).

as indicated by the arrow, and turn it, while the screw is held stationary with another lever-key.

Another modification is made by constricting one end of the barrel, after having reamed it out (see Fig. 181). This end is constricted by first closing it with gold solder and afterward drilling a hole through the centre and then screw-cutting it. The neck of the fish-tail portion is made rather smaller than the constricted portion, so that when the screw is passed through the constricted part of the barrel to its neck it will play loosely yet be securely held. To operate this jack, the barrel, like one preceding device, is turned.

FIG. 182.—Nut-jack (A).[1]

Nut-jack.[1]—Fig. 182 illustrates a very simple method of constructing a screw-jack, and one that may be improvised at short notice to meet emergencies. This is very practicable for turning opposite lateral incisors, by placing the extremities in the eyes of levers soldered to ferules cemented to the same. It may be easily made with a screw taken from a triplex-acting instrument and placing upon it a nut as shown. See Part XVI., on Turning Teeth, Vol. 2.

This jack is a modification of one I make by setting one end of the screw in a piece of tubing having a crutch-piece soldered to the opposite end, as shown in Fig. 183 (1885). A simpler plan of improvising a screw-jack, would seem hardly possible.

FIG. 183.

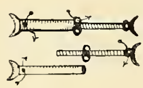


FIG. 184.

FIG. 183.—Nut and Ferule-jack (A). FIG. 184.—Nut and Ferule-jack (Angle).

Fig. 184 shows a similar jack devised by Dr. Angle (1887); the barrel end is of spindle-form, and the other of the fish-tail pattern.

One defect in my screw-jack is that it requires two lever keys, one of which is placed in the eye of the screw and the other in a hole made through the nut as indicated by arrows. The objection to all jacks that are loosely put together is

[1] Pub. in the "Independent Practitioner," July, 1886.

their liability to be swallowed by falling to pieces if dislodged. They are recommended only for temporary use.

Double Spindle-jacks.—A double spindle-jack consists of a barrel threaded inside, into one end of which is fitted a spindle-pointed screw. The other end is made solid and is spindle-pointed also.[1] Fig. 185 illustrates the elements of a set of tubes, A, A, A, A, varying in length, a stub spindle, P, and a screw, S.

Fig. 186 represents a set of completed 18 k. gold, cylindrical, spindle-pointed screw-jacks, varying from three-fourths to nearly two inches in length, which are for use transversely

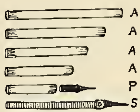


FIG. 185.—Elements of a set of Spindle-jacks.

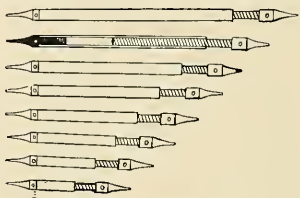


FIG. 186.—Spindle-jacks (A).

or diagonally across the dental arch. The second figure from the top is a section view showing the relation of the different parts. The stub point (black) is soldered into the ferule.

Their slender extremities may rest in pits or cavities in the teeth, substantially as illustrated in Fig. 187, but generally it is better to rest them in some little device fixed to the teeth. Such devices differ in construction, and may consist of a simple ring, R (Fig. 188), fastened to the teeth by means of a string, or they may be in the form of a socket, B L, made by soldering to this ring a short piece of small gold tubing.[2] Fig. 189 illustrates these sockets in jux-

[1] Published in "Dental Cosmos," November, 1881, p. 572.

[2] "Dental Cosmos," February, 1882.

taposition with a spindle-jack. These sockets are generally most convenient when made from one-eighth to one-fourth of an inch in length. They are to be tied to the teeth in the same manner as the rings referred to. In practice the

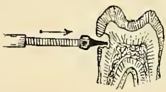


FIG. 187.—Showing application of the Spindle-jack to a Cavity by Decay.

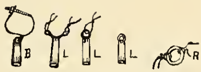


FIG. 188.—Spindle-jack Anchor Sockets (A).

jacks are first rested in the rings, and then in later stages of the operation, after the teeth have been moved somewhat and the screws are run out, they are set back into the sockets, thus avoiding a change of the screw for a longer one.

FIG. 189.—Spindle-jacks in Juxtaposition to the Sockets (A).

Another plan, found to be very practicable for holding spindle-jacks, is by pits in clamp-bands, as shown in Fig. 192,[1] or by soldering small sockets direct to them as in D, Fig. 199,[2] or by sockets linked to the bands, as in B, Fig. 188.

FIG. 190.—Ferule for the Spindle-jack.

Besides the ring socket or clamp-band (plan) is a ferule having a hole in it, set upon the tooth with phosphate of zinc. Fig. 190.

To secure screw-jacks firmly to upper front teeth has

[1] "Dental Cosmos," June, 1878, p. 311.
[2] "Dental Cosmos," Nov. 1881.

always been regarded as very difficult, and by some people impossible, because of the inclination of the lingual surfaces; but with these devices, especially the ferule, properly fixed upon the teeth, this difficulty may be conceded as overcome.

Another and somewhat clumsy device for accomplishing the same object is shown in Fig. 191.[1]

FIG. 191.—Matrix Ferule (A).

To use this device, clamp it upon the tooth, and rest the spindle-point of the screw-jack in a pit made in the end of the nut, N, or in a ring or socket soldered to some portion of the device (not shown).

To prevent the double spindle-jack from revolving while being operated, it should be held fast by a second lever-key inserted in a hole in the opposite end, see Fig. 186. Through this hole, or a ring soldered to the barrel, a thread should always be passed and tied to some tooth to prevent its being swallowed if accidentally loosened.

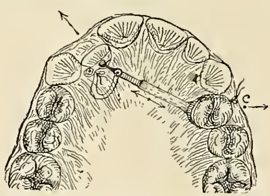


FIG. 192.—Application of a Fish-tail and Spindle-jack (A).

Fig. 192 illustrates the diagonal application of the screw-jack of the spindle and fish-tail varieties combined.

The spindle-point here rests in a pit made in the little clamp-band around the tooth to be moved; but this is not

[1] Published in "Dental Cosmos," November, 1881.

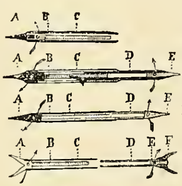
the best plan. As a rule, a ferule of thin gold cemented upon the tooth is the most satisfactory, because firmer.

Fig. 193 illustrates a single spindle-pointed jack for attachment to some kind of anchor fixture. This is usually preferred to the double spindle-jack, because it cannot become dislodged. The ring is soldered to one extremity of the barrel, and may be left closed, or cut open like a hook.

FIGS. 193 and 194 (A).

Fig. 194 illustrates a form of jack for use across the mouth to widen the arch, and to serve also as anchorage upon which to fix radial screw-jacks (Fig. 193), if desired. This jack is practically the same in construction as that shown in Fig. 193, differing by its size and strength, and having in addition a socket for the spindle extremity to play in. The value of these jacks will be shown later.

Jack-screws should always be nicely finished, and all rough places made smooth ; even then jacks, made as above described, by having the screw exposed, will sometimes irritate the tongue. To avoid this difficulty, I sometimes make a non-irritating jack, which differs from the others mainly in



FIGS. 195—198.—Non-irritating Spindle-jacks (A).[1]

[2] Published in " Dental Cosmos," about 1882.

the use of a sleeve or box, covering the rougher portions of the instrument.

They are more bulky and somewhat more difficult to construct than those previously described, but in some cases they are very desirable. Figs. 195, 196, 197, 198 are sectional views of some of the most useful modifications.

These illustrations show so clearly how the instrument operates that it will require but little further explanation than a brief mention of the different parts and their connection. Corresponding letters on the figures indicate corresponding portions, as follows:—B, screw; D, nut-ferule; C, sleeve; A, E, F, spindle-points and crutch extremities.

Fig. 195 illustrates the screw, minus the nut portion of the jack. The screw, B, having a head shaped as shown by the lighter portion of the figure, has a socket opposite the screw, in which is fastened a non-oxydizable spindle-point, A, made of platinum and iridium. Around the head of this screw is also soldered or screwed a sleeve, C, made of thin tubing which extends the entire length of the screw, as shown. The point pierced by an arrow indicates a hole for the introduction of a lever-key to operate the instrument.

Fig. 196 illustrates the screw portion, A, B, C, in connection with the nut, D. The sleeve end of this modification differs from the other device in the head, spindle-point and the screw, B, being formed of one piece of metal, instead of being made separately, and subsequently soldered to the screw. The nut portion, D, consists also of tubing, threaded inside, into one end of which is soldered a spindle-shaped piece of steel, brass, or platinum and iridium, E.

Fig. 197 illustrates a modification differing from the others by the nut-ferule, D, and spindle-point, E, being made in one piece. This is not only more difficult to make, but it, also, has no advantage over the others. The sleeve portion is thinner and less inconvenient, because less bulky.

Fig. 198 illustrates a fish-tail jack, consisting of a screw, B, and forked head, A, made of one piece, with a ferule, C, soldered to the neck, as shown, all of which remain stationary when used; while the nut portion, having a swivel-joint at the point, E, between the ferule, D, and the fork, F, is turned with a lever-key in holes shown by arrows.

Pushing-jacks with Yokes having transverse Screws.[1]—The spindle-pointed and fish-tail pushing screws for jacks, thus far described, although useful under favorable circumstances, are sometimes more or less rickety and uncertain, requiring careful management and close watching. In view of this it seems proper that, in order to meet a greater

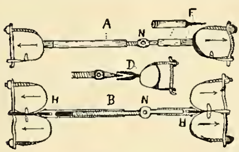


Fig. 199.

Fig. 200.

Figs. 199, 200.—Single and Double Yoke-jacks using Transverse Screws (A).

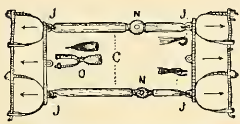


Fig. 201—Sextuple Yoke-jack, using Transverse Screws (A).

variety of circumstances, a description should be given of some of the more positive although more expensive mechanisms, containing some form of the screw-jack. These devices will for convenience be denominated yoke-jacks. They are a little complicated, but if skillfully made and properly applied they will generally remain firm. The above figures illustrate three modifications of this variety.

Fig. 199 illustrates a single jack, having a single yoke at each end made to clamp upon the teeth by transverse screws. This device is for moving two opposite teeth farther apart.

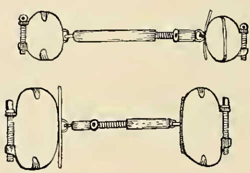
Fig. 200 is a single jack, with a double yoke at each end clamped by transverse screws, used for moving four teeth.

Fig. 201, a double screw-jack with two triple yokes,

[1] Published in "Dental Cosmos," p. 574, November, 1881.

clamped by transverse screws, used for moving six teeth. The construction of these devices is so clearly shown in the figures that they need but little further explanation.

The strongest and best yoke-bands are made of rolled platinum or gold wire. The methods of joining the yokes to the screw-jacks are various. They may be connected by a thin flexible piece of plate, F, Fig. 199, or by a rivet joint, H, Fig. 200, by staples or hooks, J, J, Fig. 201, or any other form of hinge; or they may be made detachable, and simply affixed to the teeth by sockets, D, Fig. 199; O, 201. Of course, the flexible joint obtained by these connections is



FIGS. 202, 203.—Yoke-jacks using Longitudinal Screws (A).

very desirable for free motion in case of a change in the angle of the moving teeth.

Pushing-jacks with longitudinal Screw Clamp-bands for Yokes.[1]—Figs. 202 and 203 are modifications of the yoke, consisting of a clamp-band having a longitudinal screw; a variety far more convenient than that in which the transverse screw is used. The advantage of this form of yoke over the preceding one is that it can be made to pass between teeth of any form, even if so shaped that their necks are in contact.

Fig. 204 illustrates a single band, and Fig. 205 the screw-jack independently.

[1] Published in part in the "Dental Cosmos," January, 1876, and entire in 1877.

These devices are not only of inestimable value when teeth are so tapering and adversely inclined as to render the independent jacks difficult or impossible to be used, but they may be trusted to perform their functions at all times.

The principal caution in adjusting these yoke-fixtures is to be sure to fit them so firmly that they cannot slip upon

FIG. 204 (A).

FIG. 205 (A).

the gum to injure it. Occasionally a string tied around the neck and along the sulcus of the tooth, will be sufficient; but a much better plan is to solder a small wire on the band to rest in the sulcus (see Fig. 202), or ears soldered upon some portion of the yoke so that they may be bent over the grinding surface of the tooth (see Fig. 203), or to make use of the gum-guard rings illustrated in Figs. 128, 129, 130.

CHAPTER XXVI.

MACHINES FOR WIDENING THE ARCH.

SHIFTING OF THE BEARINGS.—NUTS.—LINKS.—EVENERS FOR SIDE TEETH.

IN moving several teeth at the same time, it occasionally happens that one or more will move more rapidly than the others, rendering the case somewhat awkward if not vexatious, making it necessary to remove the mechanism for re-adjustment, and perhaps requiring more or less alteration in order to change the bearings; possibly necessitating an entirely new apparatus. This difficulty may readily be

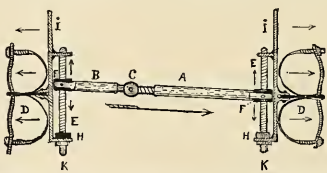


FIG. 206.—Adjustable Device for Widening the Arch (Transverse Yoke-screws) (A).[1]
A, B, C, Screw-jack; D, Adjustable yoke Clamp-band; E, F, Adjustable track screw, and carriage nut; H, Stationary nut; I, Frame; K, K, Key-nib, Adjustable buccal bar, outside.

surmounted by proper devices, but anything that will meet these varied requirements must be somewhat complicated. However, a proper combination of well-known mechanical principles is all that is essential.

Fig. 206 illustrates one variety of such an adjustable apparatus. The chief merit in this class of regulators is the ease and rapidity with which the direction and degree of

[1] Published in "Dental Cosmos," January, 1882, p. 13.

force may be changed along the line of the several teeth without removing the appliance. The apparatus (which is intended for moving the bicuspids and first molar of each side of the upper jaw) consists of three parts. First,—the yoke-clamps, D, D; second, the screw-jack, A, B, C; third, the adjusting portion, I, K, connecting the two. The yoke-clamps are in one sense auxiliaries to the screw-jack, for the reason that their office is simply to anchor it in position so firmly that it cannot slip off. These clamp-bands, which are indispensable in cases where simple impingement is impracticable, are of two varieties. One is tightened by a screw arranged transversely to the line of the dental arch, the other longitudinally to it.

Although not as readily as by the use of the longitudinal

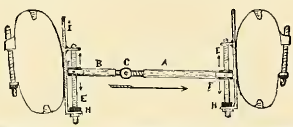


FIG. 207.—Adjustable Device for Widening the Arch (Longitudinal Screw) (A).

screw, the bands of the first variety may be made adjustable to fit different sizes of teeth by means of oval holes in the buccal bar. These allow the screws which pass through them to play one way or the other. As the construction of this form of anchor-band in principle has been explained in the preceding chapter, and also shown in the accompanying figures, it is not necessary to further describe it here.

The same may be said of the variety which is illustrated by Fig. 207, which uses the screw in the anchor-band longitudinally. If the screw-jacks in these machines are made cylindrical, it renders them less irritating and less liable to get out of order through the motion of the tongue; an agency which is more mischievous than would at first be suspected. The extremities, B, A, of this screw-jack are bifurcated in such a way as to grasp and hold the nuts, F, F, of the adjusting portion of the apparatus. This adjusting portion, E, I, H, unites the yoke-band and the jack-screw in such a manner that the ends of the jack, B, A, may be moved forward or backward by means of the screws, E, E, so that the direction of force may be changed at will by turning the nibs, K, K. This adjustable portion consists of the frames, I, I, made of a strong narrow strip of gold plate or half-round wire of sufficient length to rest against the lingual side of the bicuspids and first molars.

At right angles with each of these bars, I, and pointing toward the median line of the mouth are two projections, with a hole in each, through which pass the screws, E, E, held in place by fixed collars, H, H (one on each side of these standards). The anterior extremity, K, of each screw is made angular to fit a watch-key. These screws answer as tracks, upon which play the loose nuts, F, F, serving as carriages upon which the extremities of the screw-jacks (before referred to) rest and ride. These nuts should be of sufficient size to entirely fill the space between the track-screws, E, E, and frames, I, I, so as to rest closely against the latter, to prevent the track-screws from becoming bent and getting out of order when the force of the jack is applied.

This apparatus might at first seem uncleanly; but all that is necessary to cleanse it of food is to rinse the mouth with water. The question may also arise as to whether it is not clumsy and inconvenient to wear. It is so in small mouths, and even in large ones, in some degree, but the certainty of its action, even when made very delicate, and its comparatively painless management, make it acceptable to the wearer.

Nuts.—Fig. 208 illustrates two methods of connecting the screw-jack with the carriage nuts, F, F,—the fixed and the detachable; L represents the fixed variety as playing on pivots, or a rivet through holes in a U-shaped frame soldered to the extremity of the screw-jack. This form takes a loose yet positive hold, and answers the purpose ; but should the adjustable portion be riveted fast to the yoke-clamps, and should it become necessary to remove the screw-jacks

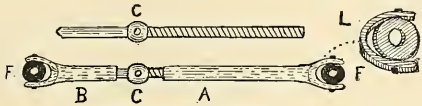


Fig. 208.—Jack-carrying Nuts (A).[1]

from the mouth, the other parts of the apparatus would necessarily follow.

Fig. 208 illustrates on a large scale the component parts of the jack and this nut. L shows the nut independently before being soldered to the jack, and F, F, as applied to the screw-jack, B, C, A.

Fig. 209, R, N, V, shows better forms of connection nuts by which the jack can be detached and removed at any time without disturbing the other portions, by simply shortening it. The peculiarities of the shape are prominences (P, P, and O, O), on the sides. These fit between the bifurcated

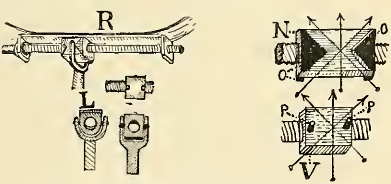


Fig. 209.—Different Forms of Jack Swivel-nuts (A).

extremities of the jack and prevent it from slipping. The arrows indicate the range—scope—of movement of the jack.

The adjustable portion of the apparatus may be fastened to the yoke-clamps about the teeth in other ways. Besides the forked method above shown, simple hooks or rings for hinges are practicable. If the screw kind of

[1] Dental Cosmos, Jan., 1882.

carriage is used, this adjusting portion should be confined to the yokes sufficiently tight to prevent unsteadiness of the machine. This may be assisted by little lugs projecting from the anchor-bands to extend through or over both sides of the bars. (Not shown in the diagram.)

To operate the entire apparatus, first fix the yoke or anchor-bands in place about the teeth; then annex the adjustable portions; finally insert the screw-jack; after which, lengthen it until it holds the nuts (F, F,) closely within its bifurcated extremities; the fixture is then in readiness to apply force to the teeth.

When it is necessary to change the direction of the force upon the teeth, turn the track-screws, E, E, with a watch-key applied to the nibs. This compels the rectangular nuts, F, F, by resting squarely against the flat bar, I, to move backward or forward upon the screw, causing the ends of the jack which ride upon them to change position. In this way the direction of the force may be given transversely or diagonally across the mouth, as desired. The *degree* of force is, of course, governed by the screw-jack. If the apparatus be properly made, not only may the jack portion be easily and speedily removed independently for repair, but the adjusting portion, also, leaving only the anchor clamp-bands.

Links.—While the anchor-bands and adjustable portion of this device are peculiarly adapted to the object desired, namely, the shifting of power, they are not easily made, and not suitable for attaching other modifications of screw-jacks. To fill a wider range of usefulness, a different plan of attaching the screw-jack to the adjustable portion of the machine will be explained. This modification, which is more easily made, utilizes the rings referred to, instead of bifurcated extremities and nuts. This is illustrated by the following diagram (Fig. 210).

This modification retains all the advantages of the device shown in Fig. 207; the clamp-band, longitudinal screw, and nuts; but instead of the adjusting frame being made inde-

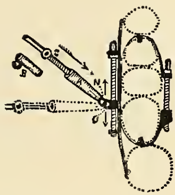


FIG. 210.—Adjustable Device, making use of the Link (A).

pendent of the anchor-band, it consists of a stiff strip of plate soldered directly to its lingual surface, as shown ; and to connect the jack with the anchor devices a ring, O, is soldered

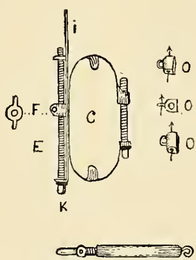


FIG. 211.—Parts of Fig. 210 shown in detail (A).

to each carriage nut, N, to which the screw-jack is connected by another ring soldered to its end. The jack rings, however, should be open, so as to allow of its detachment when necessary. Fig. 211 illustrates this modification of the adjustable machine in detail: C, anchor-baud; E, track-screw; F, O, O, different views of the carrying nut.

Means of preventing the opening of the Maxillary Suture. Fig. 212 illustrates an addition to the device shown by Fig. 210, consisting of an arm, T, made for the purpose of binding the two halves of the upper jaw together by attaching to it a jack or a wire, at S, to extend across the dental arch to fix to corresponding parts for the purpose of holding the anterior portions of the jaw together while the

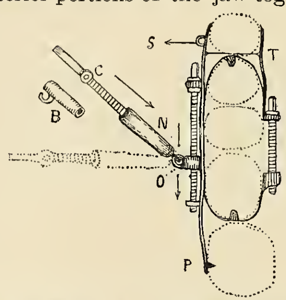


FIG. 212.—Modification of Fig. 210, showing a form of Cuspid Holder to prevent Opening of the Suture (A).

posterior portion of the dental arch is being widened, after which, in turn, this posterior portion is held fixed in place while the bicuspid region is widened. Before this is done, however, the above-mentioned addition must be removed from the cuspid, and an independent device substituted.

Figs. 213, 214, present two views of an independent stay device for this purpose, which I have found useful for preventing this accident. It consists of a jack and two bands united by two stiff cross pieces, the jack has a swivel and a nut, as shown. When these bands are made entirely of flat gold, they sometimes irritate the tongue, but if the portion of the bands that come in contact with the tongue are made of round wire, they will not chafe. To obtain firmness of the bands, however, the portions that rest on the teeth should generally be hammered flat; this will also allow of their easy adjustment between the approximal surfaces of the teeth (Fig. 215). The object of the

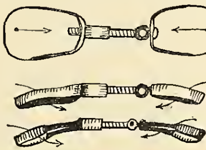


Fig. 213.

Fig. 214.

Fig. 215.

Figs. 213, 214, 215.—Ring Band Stay-jacks to prevent Opening of the Maxillary Suture (A).

independent stay-jacks is to allow liberty of action of the anterior end of the widening device, so that it will move the bicuspids outward independently of the cuspids, which is not possible by the device previously described.

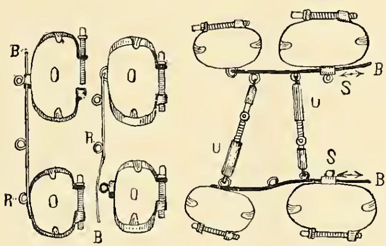


Fig. 216.—Evening Apparatus. Self-shifting Bearings (A).

Evening Apparatus for the Side Teeth.—Fig. 216 illustrates another form of adjusting apparatus for use when it is desirable to shift the bearings along the line of the arch. This shifting is caused by the sliding of the bars, B, B, through ferules, S, S, soldered to clamp-bands, O, O, or by transferring one end of the jacks, U, from one ring, R, to another on the bars, B, B.

This enlarged diagram of the self-shifting device so clearly shows the different parts, with their connections and application, that there remains but little more to explain.

These screw-jacks are of cylindrical form, and easily made of threaded tubing, and screw-cut wire having a globular nut, through which a hole is drilled for the insertion of a lever-key. This head may be turned on the screw by a lathe, or it may be made ring-like and then soldered in place on the screw, as shown. Unlike the mechanisms illustrated by Figs. 206 and 207, which are not well adapted to narrow arches, because the adjusting screw and carriage nuts interfere greatly with the tongue, this device is applicable to all arches, because the anchor-band bars are not much in the way of the tongue. In reality, the device is much more delicate than it appears to be in the engraving.

CHAPTER XXVII.

SWIVEL-JACKS.

DRAW-JACKS.—TURNING-JACKS.—BRIDLE-JACKS.

SWIVEL screw-jacks were first made for drawing upon the object of resistance by shortening the device, but if properly made they serve equally well for pushing. These jacks are of two varieties, one so fixed that it operates by turning the screw portion, the other by turning the barrel. They also vary somewhat in outline, but the main principle of their construction is similar.

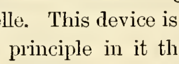


FIG. 217.—First Draw-jack devised for moving Teeth (Dwinelle).

Fig. 217, drawn from the original instrument, illustrates the first draw-jack devised for moving teeth, the invention of Dr. W. H. Dwinelle. This device is not strictly a swivel-jack, yet there is a principle in it that is common to all swivel-jacks used in dentistry. In construction this jack is similar to one of his push-jacks shown in Fig. 174, differing only in having a tack-like head made on each extremity of a spindle-like jack. These heads were made to permit turning of the jack, and were operated by resting the necks in a slot, filed in a ring-band, F, surrounding the tooth or teeth, or in a gold loop or arm, H, substantially as shown. As will be seen, all of the jacks by Dr. Dwinelle were similar in form, the barrels being skeleton.

Figs. 218 and 219 illustrate a pattern of jack published by the author in the "Dental Cosmos," in 1877, consisting of a barrel, a screw and a swivel combined, substantially as shown. As in the case of the push-jacks, previously described, a cylindrical-shaped piece of tubing of the desired size is selected, and then having cut it to the needed length, the whole of it is threaded if the tube is short, but, if long, it is first closed at one end with gold solder or by a block of platinized gold (soldered), through which is drilled a hole, and then threaded to correspond with a piece of screw-cut wire which is to serve as the screw. The outer end of this screw has a swivel-hook or ring, for the purpose of at-

Fig. 218.—Swivel Screw (A).

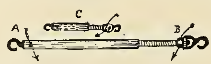


Fig. 219.—Cylindrical Swivel Screw-jack (A).

tachment to other devices, such as hooks or rings on bands, etc., bound around or otherwise attached to the teeth. The object of the swivel is to permit the turning of this screw in shortening or lengthening the jack without dislodging it. This swivel may be fixed to the screw portion of the jack, as above shown, or it may be fixed to the other end of the barrel portion in such a manner that when the hooks are attached to the anchorages the jack can be shortened or lengthened by turning the barrel portion instead of turning the screw.

A modification of the draw-jack made to act by turning the barrel, which has some merit, is illustrated by Fig. 220. The construction of this modification, which was devised by Dr. Guilford,[1] is as follows: the barrel is cut from a square

[1] "American System of Dentistry," 1887, Vol. II., p. 343.

piece of gold tubing about one-eighth of an inch diameter, which is drilled and tapped to fit a threaded gold wire about three-quarters of an inch in length, the extremity of which is bent in the form of a hook to connect it with a staple soldered to a gold band which fits around the teeth to be

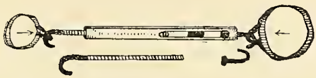


FIG. 220.—Modification of the barrel turning-jack (Guilford).

acted upon. Through this skeleton barrel, near the extremity opposite to the screw, is a slot, and near one end of it there is a plug soldered in the end of the tube, through the centre of which is drilled a hole for the introduction of a piece of wire which is headed at one end and bent in the form of a hook at the other, to catch in another tooth-band. Upon this hook the head and barrel of the jack turn swivel-like. While this device has some merit in ease of construction, it is attended with the drawback that the hook being made in the form of a "shepherd's crook," it causes the barrel of the jack to wabble around in a circular manner when turned; it is also difficult to keep clean because of

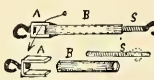


FIG. 221.
FIG. 222.

FIG. 221. —Modification of barrel-turning Draw-jack (A).
FIG. 222.—Draw-jack in detail.

its "skeleton" construction, which admits food into the barrel around the screw.

A draw-jack which in some respects resembles the above-mentioned device; simple in construction and very accurate in its movements, is illustrated by Figs. 221 and 222. The screw-hook, S, enters one end of a screw-cut piece of cylindrical tubing, B, but instead of a slot being made through the barrel, B, as shown in Fig. 220, I take a strip of gold, A, bent into two right angles, and having drilled a hole through the middle third, and inserted the wire hook, as shown in Fig. 222, it is soldered to the outer surface of the extremity of the barrel as shown in Fig. 221, after which all angular corners are rounded off, to obviate irritation of the tongue. To prevent wabbling of the instrument while it is being operated (by a right-angle lever-key placed through the rectangular hole A), the hooks are bent so that the draught will be in the direct line of the long axis of the screw, as shown.

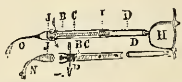


FIG. 223.—Non-irritating Cylindrical Turning-jack (A).

Non-irritating Turning-jacks.—Fig. 223 illustrates two section views of a swivel-jack, made upon the non-irritating plan. This differs from the non-irritating push-jack (Fig. 195–198) by its having, instead of a spindle-point at one extremity, a thin ribbon, O, for attachment of the jack to a clamp-band or a ferule set with cement around a tooth requiring to be turned, and at the other end a ring or hook for attachment to an anchor-band, H, which may be of the

FIG. 224.—Boxed Swivel Turning-jack (A).

transverse screw variety as here shown, or, better, the longitudinal kind. As the details of the parts making it non-irritating have already been described with Figs. 195–198, it is not necessary to further explain it in this place. It is made of 18 k. gold.

Fig. 224 illustrates a modification of the above-mentioned jacks, which is partially non-irritating and is simple in its construction. It is made as follows: To one end of a rectangular-shaped barrel, having a hook soldered to the opposite end, is soldered a threaded nut about one-eighth of an inch in thickness, for the accommodation of a screw, which has a key bulb near the free extremity, as shown (near the swivel neck). Beyond the bulb there is a head, which is enclosed in a box soldered to the extremity of a thin pliable ribbon-like piece of gold. This extremity of the gold ribbon constitutes one side of the swivel box; the other three sides are made of one piece of thin plate bent to embrace the edges of the ribbon to which it is soldered.

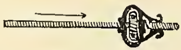


FIG. 225.—Skeleton Nut-jack (A).

Bridle-jacks.—The above figure shows a form of swivel-jack calculated for drawing different parts of devices together, such, for instance, as the chin and skull-cap portions of a harness for reducing protruding teeth or chin. This device consists of a long screw with a skeleton head-piece in which plays a nut, through both of which pass the screw as shown. To operate this device one end of the screw is fastened to the chin cap wire and the skeleton portion hooked to a ring sewed to the skull-cap, after which the nut is turned by means of a right-angle lever. See Chapters on Protruding Teeth.

CHAPTER XXVIII.

ELEMENTARY DEVICES.

A SYSTEM OF MECHANISMS FROM WHICH APPARATUS FOR VARIOUS CASES MAY BE IMPROVISED.

AMONG the valuable adjuncts of the regulator's outfit may be mentioned a set of elementary articles of different sizes, the greater number of which are in themselves complete, and from which at a moment's notice may be selected and easily arranged, regulating devices that are practicable for many cases and possibly effective for the majority. So well adapted are these instruments to various conditions of irregularity, that it may be said that it would be difficult to conceive of a case that an expert could not correct by some combination of these elements. Of course, in some cases, if devices were to be made especially, simpler forms would be preferable, because less expensive and perhaps less clumsy; but the operator, who has on hand the elementary apparatus referred to, will save much time and annoyance, and will have the satisfaction of knowing that the completion of the case by their use is almost a certainty.

The accompanying figures (226-232) illustrate collectively such a set of instruments, consisting of different sizes of anchor clamp-bands, anchor-jacks, push-jacks and draw-jacks, T's, rings and ferules. In detail these parts are as follows:

The clamp-band, Fig. 226, consists of a strip of rolled gold or platinum wire, on each end of which is soldered a nut, the bands and nut being connected by a screw, as explained in a previous chapter. For anchorage purposes, *i. e.*, for the attachment of the other devices, a staple is soldered to the opposite side of the band. To strengthen the anchor-

Fig. 227. Fig. 228

Fig. 226. Fig. 229.

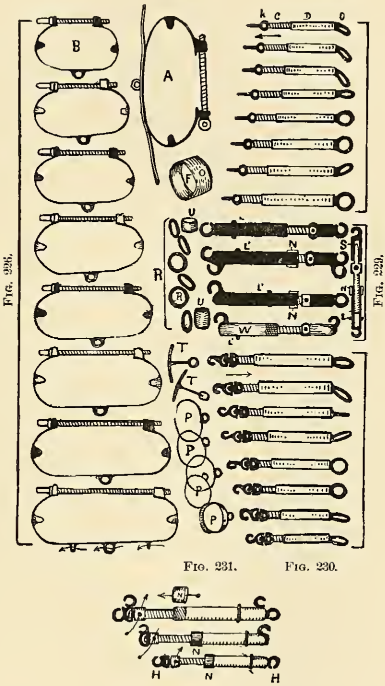


Fig. 231. Fig. 230.

Fig. 232.

Figs. 226–232.—Universal set of Instruments for Improvising purposes (A).

band and to increase the anchorage resistance in cases where opposite teeth are to be pushed outward, a bar of stiff plate, or half-round wire, may be soldered to it, as shown in A, Fig. 227.

Fig. 228 illustrates eight different sizes of push-jacks. These are made cylindrical and spindle-pointed at one end to rest in pits in the teeth to be moved, or, better, into holes made in ferules, F, cemented upon them. To the other end of the jack is soldered a wire ring for attachment of the jack to the anchorage, whatever it may be. This anchorage may be a clamp-band, a ferule or a larger jack placed across the dental arch, and fastened to anchor clamp-bands around some of the side teeth. To enable these radial jacks to reach out in the right direction from the anchorage band or a screw-jack, as the case may be, to act upon any tooth desired, these terminal rings on the jacks are soldered at different angles, as shown.

To explain briefly: these radial pushing-jacks are constructed as follows: the barrel, D, which is a threaded hollow cylinder, serves as the nut portion of the jack. Into this cylinder is fitted a screw, C; through the bulb, K, on the screw is a hole for a lever-key. This bulb is about one-eighth to one-fourth of an inch from the cylindrical or spindle end. When a pit in the tooth is used to fix the end of the jack to it, the spindle extremity of this screw should be made very slim and pointed; so also in cases where ferules, F, are used; but when a socket is to serve this purpose the extremity may be larger, yet in order to prevent wabbling, it should be nearly cylindrical so as to neatly fit the socket. It should, however, be loose enough to enable the screw to turn easily. The rings which, as before said, are soldered at different angles to the barrel portion, D (of the jacks), are made of stiff wire about the size of a pin. The method of attachment to the anchor devices will be shown in subsequent figures.

Deferring the description of the large anchor-jacks, which extend across the dental arch, let us pass to the group shown by Fig. 230. This group rudely illustrates different sizes of swivel radial jacks, devised especially for drawing outstanding teeth into line, but which are equally applicable for pushing purposes. These differ from the pushing-jacks proper (as shown in Fig. 228) in the screws having a swivel and hook on one extremity instead of its being of spindle or cylindrical form. They, however, are attached to the anchorages in the same way as the others, by rings, but the end to be used for drawing upon the teeth to be moved is attached to them by means of bands, P, P, placed around the teeth, or by T's, T, T, caught between them. To render this connection easy, little wire staples or rings are soldered to the lingual surfaces of the tooth-bands or to the lingual end of the T's, as shown in Fig. 231.

When a screw of any variety becomes injured new ones can be substituted, and when the screws and ferule nuts are all made of one size the different parts are conveniently interchangeable—that is to say, a spindle-pointed screw may be exchanged for a swivel screw and *vice-versa*. My usual plan, however, is to have three sizes of screws, and a considerable stock of each always on hand. This uniformity of sizes of parts in such devices, and a surplus number of each, are of inestimable value to the regulator of teeth, because they enable him to make repairs easily and quickly.

We have now arrived at the anchor-jacks before referred to. These are illustrated in different modifications by the group 229 and 232. As before said, they serve as supports to the above-described radial jacks, Figs. 228–230, but they are also designed to be used independently in operations for widening the dental arch. These anchor-jacks vary considerably in size, and differ in construction, some having a hook or ring at each end (one of which is on the socket piece), instead of at one end only. It also differs from widening jacks that I sometimes use (which will be illustrated in numerous places in Vol. 2), in its having a circular rib, or a knob, L, soldered on the barrel, also a ferule nut, N, screwed on one extremity. This nut is for holding the rings of the radial jacks firmly, on the section of the barrel between it and the rib or knob. The illustrations in Fig. 229 show the anchor-jacks as made after the pattern of the pushing-jack, but when the operation is prolonged, or where there is a disposition of the maxillary bones to part, they should be made in the form of swivel-jacks, as shown in Fig. 232, because more reliable for meeting emergencies and less likely to become detached. For supports to radial jacks they are superior to push-jacks.

The middle figure, R, illustrates a portion of a set of a dozen or more of gold rings made of round or half-round wire, also two of a set of short ferules, or wide rings, all of which are for the purpose of being interposed between the radial jack rings, O, to adjust them (the radial rings) between the ferule nut, N, and the rib or the knob, L. The holding of them in a fixed place upon the anchor-jacks renders the operation easier than if the jacks were rickety. The application of these rings and ferules is shown in Figs. 244 and 245.

The location of the anchor hooks or rings about the extremities of these large jacks varies to suit the differences in the plane of the two sides of the dental arch. Sometimes they are soldered to the ends of the jacks, as shown at S, at others on the side as shown in W, or both, as shown in the middle figures. This principle will be further explained in the chapters on widening and enlarging the arch, the class of operations in which they are more especially applicable.[1]

For a clearer illustration of applying these several devices or parts of devices in various ways, the reader is referred to the following fourteen figures. The first six show the use of the radial jack as applied directly to the anchor-band, the

[1] Vol. 2.

remainder their use in connection with the large anchor-jack.

Application of the Radial Jack and the Anchor-bands to the Teeth.—Fig. 233 illustrates a combination of the clamp-band and swivel-jack arranged for drawing an outstanding

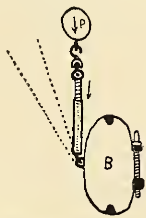


FIG. 233.—Swivel-jack and Anchor-band for Drawing (A.)

incisor into line. The jack, by staples, connects two bands; one, B, serving as anchorage; the other, P, a means of attachment to the tooth to be moved.

Fig. 234 shows how the same device may be made to serve not only to draw a tooth, F, back, but at the same time to turn it in the direction indicated by the curved arrow.

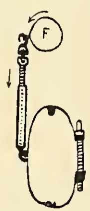


FIG. 234.—Swivel-jack and Anchor-band for Turning (A).

Fig. 235 shows how the same device may be arranged to draw protruding upper centrals into line by the addition of a T-piece.

Fig. 236 illustrates a spindle push-jack to force out to line an instanding incisor, made to act from a gold or platinum anchor ferule, F. This ferule, which has a partition to pass between the teeth, is made of sufficient size to include two

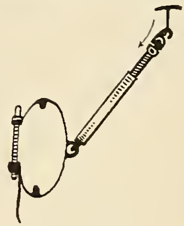


Fig. 235.—Swivel-jack and Anchor-band drawing upon a T (A).

or more side teeth, and is fixed in place upon the teeth by

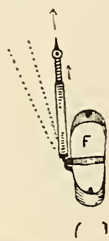


Fig. 236.—Push-jack and Anchor-ferule (A).

phosphate of zinc. To prevent the ferule from working down upon the gum, ear-pieces are attached, as shown.

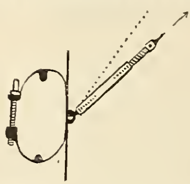


Fig. 237.—Push-jack and Anchor-band with a Bar (A).

Fig. 237 illustrates a device for forcing outward an upper instanding cuspid or bicuspid, as the case may be. This consists of a pushing jack attached to a bared anchor-band made to fit two teeth on the opposite side of the mouth.

Fig. 238 illustrates two mechanisms, similar in construc-

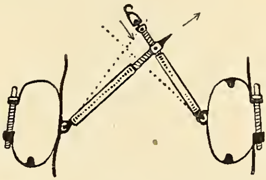


FIG. 238.—A Push and Pull-jack and bared Anchor-bands (A).

tion to those shown in Figs. 235 and 237, one to push and the other to draw. The bars are to increase the anchorage.

Fig. 239 illustrates a device consisting of a swivel-jack and two anchor-bands, which serve equally well for drawing or

FIG. 239.

FIG. 240.

FIG. 239.—Swivel-jack and Ferules (A). FIG. 240.—Push-jack and Ferules (A).

pushing, and are applicable for moving opposite outstanding or instanding bicuspids into line. This jack is anchored to the teeth by narrow stapled-ferules fitted snugly, or by broader ferules cemented to them.

Anchor-jacks.—Fig. 240 represents a pushing fixture for

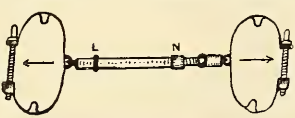


FIG. 241.—Anchor-jack and Clamp-bands as used for Pushing (A).

forcing outward instanding side teeth. Both of these latter are equally applicable for pushing obliquely as well as transversely across the mouth, but only the former is suitable for drawing purposes.

Fig. 241 is a larger but similarly made pushing device for moving, outward, opposite instanding bicuspid teeth.

Fig. 242 illustrates a union of devices consisting of two push-jacks, which is very useful for widening the upper dental arch all along the line posterior to the cuspids.

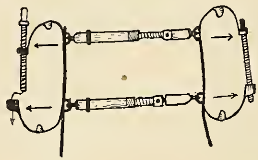


FIG. 242.—Push Anchor-jack and Clamp-bands with Extension Bars for Widening the Arch (A).

Anchor-jacks and Radial-jacks combined.—Fig. 243 shows how to improvise an apparatus for drawing into line an outstanding cuspid. It consists of a radial swivel-jack fastened to an anchor-jack (of the pushing variety). The radial-jack

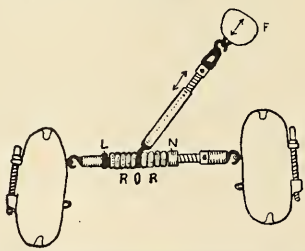


FIG. 243.—An Anchor Pushing-jack, the Radial Swivel-jack and the Clamp-band Combined (A).

is fixed in place, so as not to slip along the anchor-jack, by means of its ring, O, confined between the rings, R, R, held between the rib L, and nut N.

Fig. 244 illustrates an apparatus consisting of two pushing radial jacks resting upon an anchor pushing-jack and held in place by the rings, R, R, R, rib, L, and nut, N, as shown. The spindle may rest in a swivel, a socket crutch, or a ferule. (See Fig. 250.)

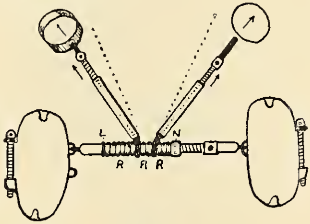


FIG. 244.—Anchor-jack and Radial Push-jacks (A).

Fig. 245 represents a swivel radial-jack attached to an anchor-jack for the purpose of drawing back central incisors, by the aid of a T-piece placed between them. The radial-jack is here shown as being held in place by short ferules, U, U, instead of rings.

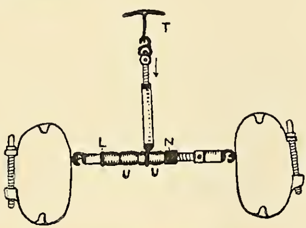


FIG. 245.—Combination of the Anchor-jack and the Swivel-jack with a T-piece (A).

Fig. 246 illustrates a somewhat clumsy apparatus improvised for turning two upper centrals. This consists of one pull and two push-jacks resting upon an anchor-jack, which in turn is linked to two anchor-bands as shown. The spindle extremities of the push-jacks are fixed in place upon the centrals by means of gold ferules, F, cemented upon them, while the draw-jack is held in place by a T-piece, T.

The direction that the screws should move in order to make the sides of the teeth turn in the course shown by the arrows on the labial sides of the teeth, is indicated by other arrows alongside of the jacks.

In manufacturing anchor-jacks it is important that they should be well made, or they will spring "out of true" when force is applied to them by the radial jacks. If the push-jack pattern is used, the socket should be at least

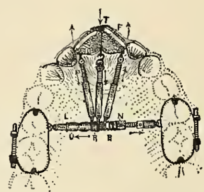


FIG. 246.—Combination of the Anchor-jack, two Pushing Radial-jacks, a Swivel-jack and two Clamp-bands (A).

three-eighths of an inch in length, but if the swivel pattern is used the liability of springing out of true is less.

These illustrations of different combinations of elementary instruments, belonging to this set, will probably suffice to show conclusively that many other and different combinations will readily suggest themselves for meeting the varied requirements of cases in practice; therefore, it will not be necessary to increase the number of illustrations. For an explanation of the arrangement of these elementary parts for increasing the entire arch, the reader is referred to the chapters on Fan-shaped Devices for Enlarging the Arch, Vol. 2.

CHAPTER XXIX.

TAIL-JACKS.

IMPROVISABLE TAIL-JACKS.—FOR PUSHING.—FOR DRAWING. —GENERAL ADAPTABILITY.[1]

TOGETHER with the last-described system of devices may be mentioned another which I denominate the tail-jack system, because the jacks have appendages resembling the tails of small animals. These jacks are designed for improvising for immediate use, and are especially adapted for being applied to plates at short notice, but they are also applicable to nearly all other kinds of anchorage devices. They are of two varieties, each variety being in three sizes and of a greater number of lengths; for convenience of interchange of parts. However, the sizes of the screws should be limited to two or three. One of these varieties of jacks is intended for pushing against teeth, the other for pulling upon them. The distinctive feature in the construction of these jacks is the tail-like appendages, which are of platinum or gold wire of indefinite lengths, soldered to different parts, some at the end of the barrel opposite to the spindle or to the swivel extremity, as shown in Fig. 247, and on the swivel-jacks at or near the swivel end of the barrel, as well as the distal end, as shown in the upper diagram of Fig. 248. The form of the latter wire, as it appears before being soldered to the jack, is shown independently beside the lower diagram in the same figure.

[1] Lecture, Feb. 27, 1888. "Brooklyn Medical Journal," July, 1888.

The object of these tail-wires is to quickly fasten the jacks to any plate in an improvised manner by passing them through holes drilled for the purpose in it, and then bending or heading them down on the opposite side, or by twisting the extremities together, and then hammering them into

FIG. 247. FIG. 248.

FIGS. 247 and 248.—Improvisable Tail-jacks (A).

counter-sinks cut into the back of the plate. To obtain sufficient room for this counter-sink without cutting through the plate, the holes for the wires should be drilled through a thick portion. This portion is, sometimes, only to be found in a rugose (rugæ) ridge (see Fig. 249).

One virtue of these improvisable tail-jacks is their accommodating adaptability to different situations on the same plate, whenever circumstances call for a change in the

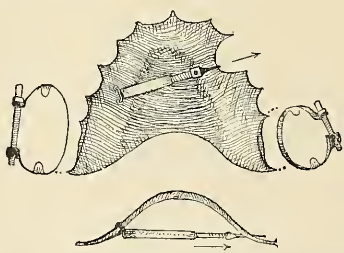


FIG. 249.—Tail-jack as applied to a Rubber Plate with independent Anchor-bands (A).

direction of force, thus avoiding the waste of time necessary to the vulcanizing process in the making of a new plate. The idea of making these jacks was suggested to my mind by the displacement of jacks on the cast during the process of being vulcanized to plates when made in the old way, the displacement sometimes being so great that it was impossible to give the force in the right direction. Even in such cases, all that is necessary is to cut out the misplaced jack, and (in the proper place) substitute one of these jacks for it.

To render these instruments of the highest value in an operation, they should be connected firmly with the plate, though not necessarily to the degree of rigidity caused by the vulcanizing process. With push-jacks it is necessary to so anchor them to the plate that the main strain when in use shall fall upon the side of the plate, opposite to the spindle end, the anterior end being simply held down to the plate by an independent staple made of platinum wire set in it. The object of causing the force of resistance to bear upon the side of the plate opposite to the tooth borne upon, is to prevent springing or doubling of the plate, which would occur to a thin plate if the push-jack should be fixed to the side of the plate next to the tooth to be moved. With the draw-jacks, however, it is quite different. The fixed point in such cases should be on the side of the plate next to the tooth to be moved, while the opposite end should be loosely, yet firmly attached by the tail-wires. But the same end may be obtained by independent staples. To prevent the reactive force of the screw from pushing too powerfully upon the tail-wires, the base of the jack should be set against a shoulder made on or in the plate. As will be seen by the figures, these jacks are simple and very easily made, and that in form they resemble jacks that have previously been described, varying from them only in the association of the wires.

Wires, that are intended to be twisted around each other should be of platinum, about the size of a pin, because this metal is pliable; but if it is intended to be bent like a fish-hook it should be of larger size or else of gold, in order that the hook shall not straighten when subjected to the force of the jack. The method of adjusting the latter size of wire will, of course, depend upon circumstances, but probably that which will be regarded as the easiest and at the same time least inconvenient to the patient is by the fish-hook plan. This consists in bending a wire double, and soldering the U-shaped extremity to the jack, and then, having passed the free extremities through a hole in the plate, these wires are bent in different directions, one of which, used with push-jacks, should always point from the tooth to be moved, and with draw-jacks, toward the tooth to be moved.

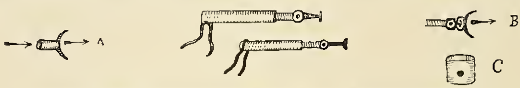


FIG. 250.—Socket Crutch; Tack-head Screw-jack; Swivelled Crutch (A).

To apply force to an instanding tooth by a spindle-jack, may require a crutch, or ferule, to hold the jack in position on the tooth (A, B, C, Fig. 250). If a ferule is not at hand, and there is not sufficient time to make one, if the jack-barrel is firmly fixed to the plate, the tooth can be moved by substituting for the spindle-screw a tack-head screw, shaped as shown in the two middle figures. The head, which is about an eighth of an inch in diameter, if resting on the neck of a lateral, and half buried beneath the gum, will so bear upon the tooth that it will generally be sufficient to move it.

Should the tooth be in a position that would cause the tack-head to slide off, the head may be made to rest secure by a piece of gold spring-wire anchored at one end into the central part of the plate, thence extending along in contact with it to the tooth, then turning at a right angle, dip its flattened extremity between the tooth and the tack-head, extending a little way beneath the surface of the gum, to make a perpendicular bearing for the tack-head. (See Righting-up of Horizontal Teeth, H. Case, Part XV., Vol. 2.)

CHAPTER XXX.

THE LONG-BAND.

THE MEANS OF ANCHORAGE.—STRINGS.—CLASPS.—HOOKS.—T-PIECES AND FERULES.

AMONG the various plans of applying force to the teeth one is through the agency of strip-bands described by Fauchard (1746) and Bourdet (1786).[1] The plan is to bend or corrugate long narrow strips of metal in such wise that they will draw or push upon the teeth to be moved. Metallic strips, generally of gold, may extend along the line of the dental arch, or from one tooth to another across the mouth. Postponing their application to Vol. 2, attention is now called to the long-band for regulating instanding front teeth. This consists of a long strip tied with strings or otherwise to the teeth of one or both sides of the arch. Having bent the strip in the form of an arch, it was formerly laid along the labial surfaces of the teeth so as to arch over the instanding front ones, thence to the opposite sides of the arch, where the extremities were tied to the corresponding (opposite) teeth. The breadth of this long-band was from about one-sixteenth to one-eighth of an inch, and it was long enough, as before implied, to extend from one side of the arch over and beyond the irregular teeth. As has been said, the old way of fastening the extremities of these long-bands was by means of strings, and often at the present time the method of attaching it to the teeth is also by strings. When such material

[1] See foot-note, p. 377.

is used for any of the teeth, it is important, of course, that new strings should be substituted for the former ones

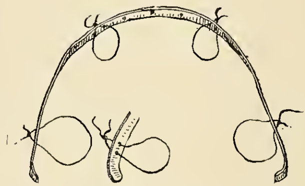
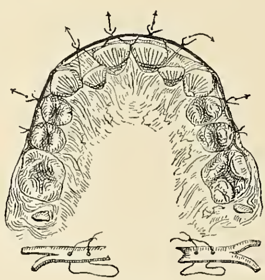


Fig. 251.—Top view of the old style Long-band, with its Strings.

whenever the tension is weakened by the action of the saliva on the material.

Fig. 251 is an illustration of this old device as it appeared with the strings attached. To increase the steadiness of the



Figs. 252 and 253.—Appearance of the old style Long-band as Applied and Tied with Strings.

front portion of the band, it was sometimes necessary to tie it to one or two front teeth, other than those to be moved.

Fig. 252 shows the bottom view of this long-band as applied to the upper jaw, and in the act of drawing outward the right instanding lateral, and drawing outward and simultaneously turning its mate, making use of the bicuspids as anchorages for the device. Fig. 253 gives a front view of the extremities of this long-band. The action of the teeth drawn upon, whether for turning or moving them in a direct line, depends upon the method of applying the string. This is wound around the tooth and then tied, after which it is passed through holes in the band and then drawn tight and tied again. To prevent the extremities of the

FIGS. 254 and 255.—Old Style Band as applied for the Correction of Lower Incisor Teeth.

long-band from being forced backward by this draught, they are split and oppositely bent, so as to rest between and upon the teeth as shown. Although in some degree unsteady, this device, if properly made and applied, is not only extremely simple, but effective, and for easy cases is sometimes thought to be preferable to more complicated ones. In my practice, however, it was long ago superseded by better apparatus, the most useful varieties of which will be explained later.

Figs. 254 and 255 illustrate such devices when applied for correction of irregular incisors of the lower jaw. The plan has been so plainly shown in the preceding paragraph that it is unnecessary to dwell upon it.

Instead of metallic strips for long bands, strips of bamboo are sometimes used; this material, however, when saturated with the fluids of the mouth, becomes offensive. (Fig. 256.)

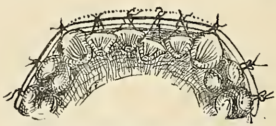


FIG. 256.—Bamboo Long-band (old).

About 1825, tying of the extremities of the long-band was improved upon by Desirabode, who soldered on them ferules and thimble crowns to fit over the back teeth, rendering it easy to remove the band for cleansing, and at the same time renewing the tension strings. Clasps were soon after used. (See Fig. 257.)

One difficulty encountered in using these earlier forms of bands was how to confine them in place along the front teeth,

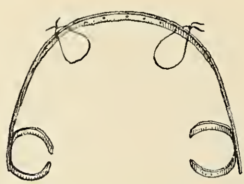


FIG. 257.—Combination of Long-band with Clasps (old style).

so that they should not slip up or down. To make them reliable for direct pressure, tying with threads was not always sufficient, because when wet, the threads would stretch, and the knots pull out of place or untie.[1]

[1] "Knots," published by the author in "Dental Cosmos," 1878.

To prevent the band from thus slipping, a T-piece, such as is shown in Fig. 258,[1] was soldered to the middle point, also a sliding T, Fig. 259,[2] which played along the band. Figs. 260[3] and 261 illustrate a screw T independent, and as applied to the extremity of a long-band, for fastening it to the side teeth. These extremities were tightened by means of the nuts, as shown.

T's, like those shown in 258 and 259, when resting on the labial surfaces of the incisor teeth, will prevent the long-band from impinging on the gum, but they are of little or no use to prevent the band from slipping off the teeth; nor have I ever found a more secure method of

Fig. 258. Fig. 259. Fig. 260. Fig. 261.

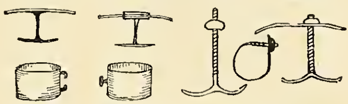


Fig. 262. Fig. 263. Fig. 264.

Figs. 258—264.—T-pieces (A), Ferules with Lugs.

holding the anterior portion of the band, except through the agency of long screws, fastening the long-band to the anchor clamp-bands (to be described further on), than by the use of strings passed through holes in the band, and tied to the teeth, or by lugs on ferules cemented to the teeth with phosphate of zinc.

It has been thought that T's and hooks, in connection with long-bands, for bearing upon the lingual surfaces of incisors, are useful for drawing them outward, but experience proves them to be useless for this purpose, because of the inclination of the lingual surfaces, which causes them to slip off.

[1] Author's Dental Register, Vol. II. (1876), p. 385. Published in "Dental Cosmos," June, 1878, Fig. 22, p. 308.

[2] Devised in 1879, (Hall case).

[3] Devised in 1873, (T. Mead case), Dental Register, Vol. I. p. 19. See T, Fig. 67, p. 169, included among apparatus used in a case published January, 1876.

Even for anchoring extremities of long-bands to the side teeth, they are greatly inferior to screw clamp-bands.

The use of narrow, flat rings for such purposes is very old, but I took the idea of broad ferules from seeing Dr. Bogue (in 1877) use one to save a badly broken and decayed bicuspid, by leaving the ferule permanently on the tooth, and filling it with amalgam. Such ferules, if set upon the teeth with zinc cement, make it possible to accomplish much, if favorably shaped, or by knobs or hooks soldered to them, for the band to rest upon or between. (See Figs. 262, 263.) In using such fastenings, however, it is important that the ferules should be as broad as the antagonism of the tooth will permit, and the long-band so rested that its force when applied will not tend to

Fig. 265.—Anchor Device (A).

drive the ferule off. Such direction of force is not only liable to loosen the ferule, but to raise the teeth from the socket.

Anchor devices.—Fig. 265 is an illustration of a more simple form of screw anchorage published by me in 1877,[1] but this size is more effective for connecting screw-jacks, by means of staples soldered at convenient points upon them, than for long bands. The anchorage afforded by a single tooth (though practicable) is not equal to that given by a band made large enough to extend around several teeth. Various modifications of these bands have been explained. Any one of these devices is (as a general rule) preferable to the screw T. Figs. 266, 267, 268 represent modified forms

[1] "Dental Cosmos," October, 1877.

of my earlier devices for anchoring long-bands. Those shown in Fig. 266 consisted of a gold or platinum ribbon, having a rectangular loop of flat wire of a size and shape to fit around the extremity of the long-band. This rec-

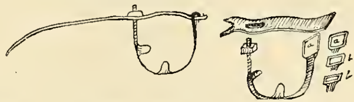


FIG. 266.—Combination of Long-band and Single Transverse Screw-loop Anchor-band[1] (A.)

tangular ring is then slided on the extremity of the long-band, and tightened to it by means of a nut on a screw passed through an oval hole in the long-band as shown.

Fig. 267 is a modification of the same device, both ends having screws which play in oval holes in the long-band.

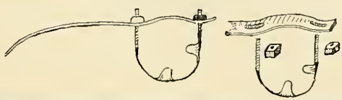


FIG. 267.—Combination of Long-band and Band having two Transverse Screws[2] (A).

Fig. 268 illustrates quite a different form, operated with a thumb-screw forced against the long-band, which has no holes through it. The thumb-screw draws the tooth-band upon the tooth, as the nut lifts from it by the screw.

It might be thought that round gold or platinum wire

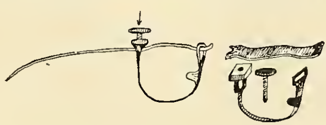


FIG. 268.—Combination of Long-band and Thumb-screw Anchor-band (A).

would serve quite as well for tooth-bands as thin ribbon, but experiments which I made with them as early as 1873 proved to me that wire is of limited value for this purpose.

[1] "Dental Cosmos," June, 1878. [2] Ibid.

Except in rare cases, round wire and transverse screws are difficult to apply because of insufficient space between the teeth. For this reason, I rarely use them now, preferring clamp-bands of rolled wire, with longitudinal bolts. These can be easily placed between the teeth and as easily tightened. Still, as these devices with transverse screws are occasionally useful, it is desirable to bear them in mind.

To prevent these anchor-bands from slipping down on the teeth or on the gum, as already mentioned in this work, ears[1] should be made on them, to extend over and upon the antagonizing surfaces, and to rest in the antero-posterior sulci of the teeth. If the ears rest over the buccal or

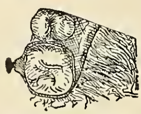


FIG. 269.—Thumb-screw and Plate[2] (A).

lingual sides, they will often be found to be in the way of the antagonism of the teeth.

When long-bands are anchored to plates, the latter are fixed to the teeth in various ways. Fig. 269 illustrates a method of fastening a plate to teeth by means of a thumb-screw applied through a tooth-ring, so as to impinge directly upon the tooth. One drawback of this plan (published in 1879) is the same as that which was found with transverse screws—that is, inconvenience of location and approach for tightening the screw. The strongest and best plan of fixing plates to anchor-teeth is by means of clamp-bands. (Fig. 89, p. 219.) This will be hereafter shown.

Fig. 270 illustrates a modification of the above thumb-screw means of anchorage. This is for fixing the long-

[1] First published in the "Dental Cosmos," January, 1876.

[2] "Dental Cosmos," June, 1879.

band, and was published in 1883 by Dr. Patrick. It consists of a tooth ferule made to fit around a side tooth, selected for an anchor tooth, and then upon the buccal side is soldered a small rectangular-shaped ferule of flat metal of a size and form to fit the long-band, which is to rest in it,

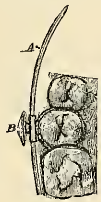


FIG. 270.—Thumb-screw and Long-band (Patrick).

and which is fixed in place by the impingement of the thumb-screw on it, but not on the tooth. The firmness of the long-band depends upon the fit of the ferule around the tooth, which probably would be made more steady by the aid of phosphate of zinc cement.

Anchorage of the long-band soldered to flat metallic rings,

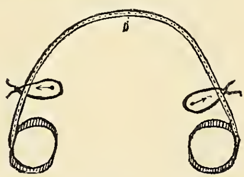


FIG. 271.—Long-band Soldered to Tooth-rings (old).

as practised by some of the older dentists, sometimes affords a satisfactory degree of firmness; usually, however, they are rickety and unreliable. See Fig. 271. The corrugation or bending of the long-band, so that it will bear upon outstanding teeth, will cause them to move into line. Fig. 272, which illustrates a modification of the above by Dr. Byrnes, shows this principle. Corrugation is mentioned by Salter (p. 49, edition of 1875).

Fig. 271 illustrates this old method of constructing devices for the purpose of drawing, outward, instanding bicuspids, but by using in this way the simple long-

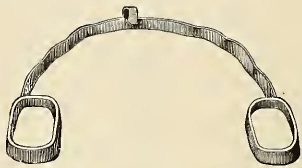


Fig. 272.—Corrugated Long-band (Byrnes).

band the anchorage is weak, and is not always sufficient to enable the traction strings to act in the right direction, because one extremity of the string riding upon the upper surface of the flat or half-round long-band, the other below it, the elevation of the string on one side, and its depression on the other, render it liable to slip off the teeth.

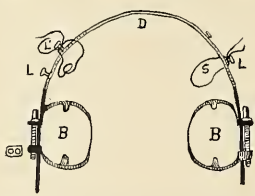


Fig. 273.—Combination of Tie-lugs with the Long-band anchored to Anchor Clamp-bands (A).

Fig. 273 illustrates an improvement upon the device, above described, made by combining a clamp-band with the long-band, the extremities of the latter extending beyond the clamp-bands so that they can be bent to rest on the antagonized surfaces of the posterior molars. On each side of the long-bands, there are also fixed by solder two small lugs, which project to or from the gum about one-eighth of an inch, and to which the instanding teeth are tied. The object of these is to overcome the difficulty referred to in describing Fig. 271. The idea of these lugs I adopted from a hard-rubber plate device made by Dr. H. F. Baynes for correcting lower incisor teeth.

Of all the means for attaching the strip-band to the anchor device, none seems to me to be equal to the screw (which so far as I know was not attached in this way prior to my doing it). The plan is shown in Fig. 274, and consists in a combination of the short-band, S, or long-band, P, with a nut, N. The clamp-band is connected by a screw passing through this smooth-bored nut into a nut on the clamp-band.[1] For esthetic purposes, I sometimes solder artificial teeth to a wire band (shown in T), as when drawing in protruding laterals when the centrals are lost.

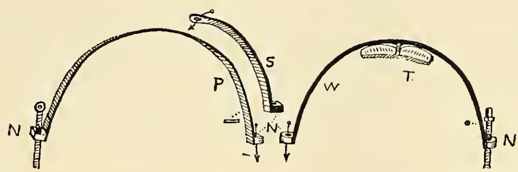


FIG. 274.—Combination of the Long and the Short-band and Screw (A).

This form of band I have found to be of so great a value in regulating, that in various modifications it now constitutes the principle of several of my best devices for correcting teeth. This pattern of band is also practicable in connection with rubber plates as anchorages, and is now used by some eminent dentists. A few modifications will be shown.

[1] Published in the "Dental Cosmos" in part, in Jan., 1876, and the conclusion in June, 1878. Devised, 1872.

Fig. 275 from Magitot's "Dental Anomalies," Plate XIII.,[1] as taken from Langsdorff, illustrates a combination of a portion of a long-band acting as a hook, with a partial plate devised for the purpose of drawing backward protruding centrals for a young patient. As will be seen, this band of Langsdorff's, which is similar to a portion of a long-band, serving, as Magitot states it, as a spring, passes anteriorly around and is hooked upon the anterior portion of the dental

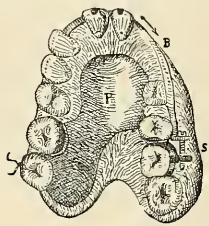


FIG. 275.—Partial Long-band acting as a Spring (Langsdorff).

arch, and attached by a screw, S, (extending from the other end of the spring, B,) with a nut-arm projecting from the buccal side of a narrow single tooth-ferule around a molar tooth. The hook principle may be used in various ways in con-

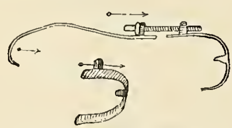


FIG. 276.—Draw-hook Device (A).

structing devices for moving teeth. In 1872 I devised and used a hook and screw (Fig. 276) to move a cuspid, which worked so advantageously that I have used it occasionally since, but these hooks were rigid not elastic.[2] In operating

---

[1] Published, 1877.

[2] See Chapter on "Correction of Cuspids," Part XV., Vol. 2.

this device of Langsdorff's, which is constructed by a combination of the positive and probable principles of mechanics, the traction upon the teeth is made by turning the screw, S, which draws upon the hook to the desired degree, when it is left until the direct draught caused by the screw, and in addition the force of the elasticity of the hook, are nearly or quite spent, when the device is again tightened upon the teeth by turning the screw.

Fig. 277, from Tomes' "Dental Surgery" (1887), is another modification of the combination of a long-band of thin gold with a nearly full plate, which covers not only most of the

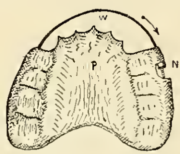


FIG. 277.—Long-band in combination with a Plate covering the Side Teeth (Tomes).

hard part of the roof of the mouth, but also covers and fits tightly all of the side teeth. One end of this long-band, W, is vulcanized into the (patient's) right side of the plate, P, while the other extremity, which is screw-cut, passes through a projection on the left side of the plate, and is tightened upon the teeth by a nut, N. This form of plate often furnishes a fairly firm anchorage to the long-band, and is useful as a means to this end; but plates covering the teeth should be frequently removed, and kept scrupulously clean; otherwise, the decomposition of the débris which always collects under them will injure the teeth by softening the enamel.

Fig. 278 illustrates a combination of the long-band with a plate, devised by the author. This instrument, which is occasionally valuable, is constructed as follows: A plate, P, having a clamp-band, B, vulcanized to each side of it, is made to serve as anchorage, to which the long-band is fastened, as shown. To increase the anchorage resistance, clasps, C C, are added, so as to utilize the posterior molars, which were too short to be bound by the clamp-bands.

In applying this device, the plate, P, is first bound to the side teeth, after which the long-band, W, first bent so as to bear properly on the anterior teeth, is fastened to the double nuts on the clamp-bands by means of screws, S S. This form of device is remarkable for its strength of anchorage, and is capable of an almost indefinite degree of force without becoming dislodged; but, of course, this device, like

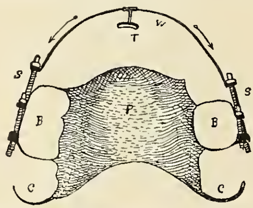


FIG. 278.—Long-band in combination with a Plate having Anchor-bands (A).

any other depending solely on the side teeth for anchorage, should be operated cautiously in order to guard against causing these anchor teeth to move forward too much. When it is found that these teeth afford insufficient anchorage, the skull-cap or the bridle should be brought into requisition to aid from the back of the head.[1] When the anterior portion of the arch is too broad, and it is desirable to force the laterals and cuspids inward, all that is necessary is to so bend the long-band that it will bear upon these teeth in the lingual direction. This act is seldom necessary except in the case of dwarfs.

Fig. 279 illustrates a method of associating the long-band and screws with single tooth ferules, by means of nuts sol-

[1] See Part XIX., Vol. 2.

dered to the buccal side of the ferules, as shown. This size of ferule, however, is not so useful as a band made large enough to enclose two teeth, or by two or more single tooth-ferules soldered together after the Barrett plan.

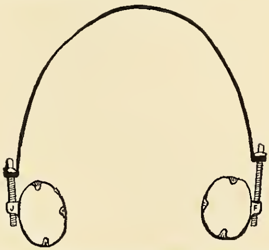


Fig. 279.—Long-band Screwed to single-tooth Ferules.

Fig. 280 illustrates a method of securing screws to long-bands, which may be denominated the *rigid*-plan. This plan, the object of which is to steady the band, so that it will not force the front teeth up or down (unless it is desired to elevate or depress them in their sockets),

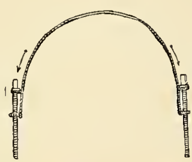


Fig. 280.—Double-lug Long-band (A).

differs from the preceding one in having two smooth nuts on each extremity instead of one. These are about one-fourth of an inch apart. The same end (steadiness) may, however, be obtained by one long tube-like nut on each extremity, but unless the screws are straight and true they are not so convenient to operate with as two nuts.

When longitudinal screw clamp-bands are used for anchoring the long front-band, the apparatus is applied to the teeth as follows: The anchor-band is first bound around one or more posterior teeth that are suitable for anchorage on each side of the mouth, the screws lying outside and longitudinally with the gums. The object of placing the screws on the buccal side of the teeth is to prevent irritation of the tongue, which would be apt to occur if they were placed upon the lingual side of the teeth. There are cases, however, which call for placing the draught screw on the lingual side. Fig. 281 illustrates such a modification of the clamp-band, which I published in February, 1879.[1]

Having the anchor-bands securely fastened to the side teeth, the long-band is then attached to them by means

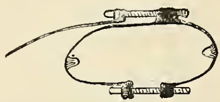


FIG. 281.—Opposite Nut Anchor-band (A).

of the screws entering the posterior nuts on this band, the nuts, as before said, being made double or triple for the attachment of such auxiliaries. The long-band should, of course, be made of round or flat gold wire to secure toughness, and of a size that will render it stiff enough to prevent its being too easily bent while in use. This long-band, which is usually punctured with string-holes in places off against the teeth to be moved, is then made taut upon the teeth by the last-mentioned bolts, screwed into the triple nuts of the anchor-bands, after which the instanding teeth are tied to the band with strings in such a manner that they will be drawn toward it. Sometimes rubber rings are preferable to strings, see Fig. 293.

[1] "Dental Cosmos," February, 1879.

When there are outstanding teeth, this long-band may be made to contribute toward forcing them inward by so bending it as to bear upon them. Of course it is important, as before said, to have the long-band so formed and bent that it will rest easily upon the teeth, and without a tendency to spring upward or downward upon them, as this tension is liable to force the teeth which are tied to the band to sink or rise in their sockets.

Besides the above-mentioned plan, I sometimes make the screws to lock with this band, so that they cannot become detached from it. This is to enable the long-band to be forced forward as well as backward. Three modifications of this plan are illustrated by Figs. 282, 283 and 285.

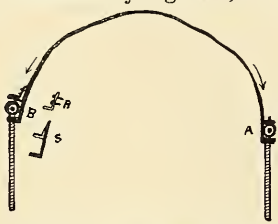


FIG. 282.—Lock-screw Long-band (A).

Fig. 282 shows the simplest plan of locking the screws. The construction of this device is as follows: Having soldered a nut at right angles to each end of the long-band, a bolt is run through each to the heads, and then another nut or a piece of plate, S, bent at right angles, is soldered just above each on the long-band, as shown, to hold the screws in place; sometimes this piece of plate, R, after being bent, may be riveted to the band, but this plan weakens it. The head of such bolts may be round as at B, or spindle-shaped as at A. If of spindle shape, it should rest in a hole through the second nut piece, as shown.[1]

[1] 1881. Published in "Dental Cosmos," March, 1886.

All things considered, the best plan of locking the screws is to have two collars soldered to the screw, between which the long-band nut is placed. This construction of fixture which I originated for a case[1] in January 1881, (and used in various modifications since, and on November 3, 1885, exhibited with other devices at a lecture,[2]) was published in the "Dental Cosmos," March, 1886. The long-band may be fixed to the clamp-band by being screwed to a double or triple nut on the longitudinal screw side, as shown in Fig. 283, or to a separate nut soldered to the

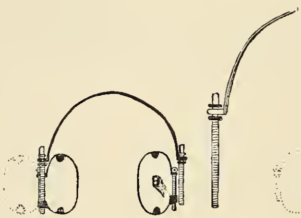


Fig. 283.—Lock Screw Long-band for the Longitudinal Screw-nut of an Anchor-band (A).

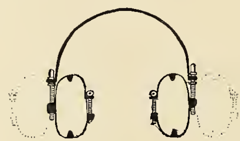


Fig. 284.—Lock Screw-band fixed to the opposite side of the Anchor-band (A).

plain side of the anchor-band, as shown in Fig. 284, which is the same form of anchor-band as published in the "Dental Cosmos," February, 1879. The latter plan, however, is not as convenient to wear, as that shown in Fig. 283, because the lingual screw interferes with the tongue. The middle figure clearly shows the lock.

The special virtue of these lock long-bands is the ease with which they can be operated, by simply turning the screws.

Fig. 285 shows two modifications of the above plan

[1] Author's Dental Register, Vol. 6, p. 131, 1881. (Case of H. Dougherty.)

[2] Before the First District Dental Society of the State of New York.

for locking the long-band, as they appear attached to ferules or flat anchor-rings. This band is tightened on the (patient's) right side by advancing the lock screw posteriorly through two nuts soldered to the ferule, but on the other side it is accomplished differently, by turning a globular nut which plays between two ear-lugs. By this latter plan the screw and long-band are one. With any of these lock-screw devices, all that is necessary to force in either direction the teeth that are tied to the long-band, is to turn the screws backward or forward. This either pushes

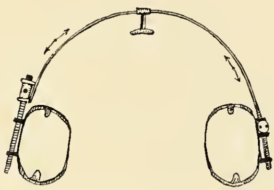


Fig. 285.—Two Methods of Locking a Long-band to Anchor-ferules (A).

or draws the band, thus dragging, by the strings, the teeth that are tied to it.

Besides strings for drawing the anterior teeth to the long-band, various forms of metallic T's and hooks have been tried, but, as before said, they are not reliable, because the inclined surfaces of the lingual walls of these teeth permit them to slip off easily. For securing anterior teeth to long-bands, there is, so far as I know, no metallic device which can be successfully applied to naked tapering surfaces. If the teeth are previously feruled so as to present an advantageous shape, T's are sometimes useful.

Fig. 286 illustrates a combination of the rigid long-band, B, and screws, S, S, with large anchor ferules, F, F, having partitions to steady them when cemented upon the anchor teeth. These ferules are made of gold or platinum, and should be about as broad as the crowns of the teeth are long, and to prevent them from injuring the gum by slip-

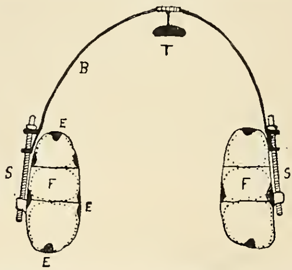


Fig. 286.—Double-lug Long-band Screwed to Partitioned Anchor-ferules (A).

ping, the antagonizing edges should be turned inward at right angles, as shown at E, E.

My experience with these long ferules is that they are liable to cause pain, unless they are made large enough to fit upon the teeth in such a manner that they will not cause an uneven strain. Especially is this so with adult patients, to whom such pressure is more disagreeable than to children.

Fig. 287.—Other plans of Anchoring the Screw Long-band.

One method of making anchor-ferules is to have several single-tooth ferules made to fit the anchor teeth closely, but yet sufficiently loose to allow of their being removed.

Having taken an impression of the teeth, while the ferules are on them, make a plaster and asbestos cast, and solder them together. This method was first made known to me by Drs. Barrett and Boswell, who, so far as my knowledge extends, were the first to use it.[1] The principle most insisted on by the devisers of this union of ferules, is the fitting of them so closely to the teeth that the draught of the long-band will act directly upon the entire length of the teeth, and without tilting them. After the ferules are soldered together, each end of the long-band is connected by means of a screw[2] entering a nut soldered on the rear portion of the group of ferules, as shown. For additional support to the long-band, a gold loop through which it passes is also soldered to the anterior part of the group of ferules (B, Fig. 287).

A, C (Fig. 287), shows the form of two modifications of anchors of mine, one using the screw transversely, the other longitudinally, and both having the long-band connecting nut on the end of an arm. These anchors are also available for the attachment of wire arms and drag-screws.

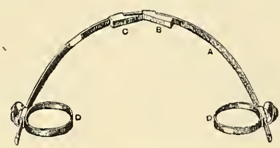


FIG. 288.— Combination of the Long-band and metallic Slide-wedge (Patrick).

The long-band has for many years been used by Tomes and others as a means of holding blocks of wood or rubber to bear against the teeth lingually. This was done by interposing the blocks between the bands and the teeth to be moved. In 1883, Dr. Patrick patented a combination of the long-band, A, with sliding wedges of gold, C, B, thumb screws, and tooth rings, D, D, as shown in Fig. 288.[3]

---

[1] 1887, W. C. B.; H. H. B. [2] After author's plan, p. 323.

[3] In 1887, Dr. Patrick, as an improvement, substituted (for the ferules, D, D, and the thumb-screws) clamp-bands and lock-screws, similar to those the author published several years before. See pp. 328–330.

CHAPTER XXXI.

CANTILEVER DEVICES.

FOR DRAWING INSTANDING AND OUTSTANDING TEETH TO LINE.

A DEVICE for drawing out to line an instanding upper cuspid is shown in Fig. 289. This mechanism, which was published in 1878,[1] consists of a bridge, a clamp-band and a screw with a ring on one extremity. The plan of construction is as follows: A strip of gold plate or clasp metal, about No. 20 in thickness and one-eighth of an inch in width,

FIG. 289.—Cantilever device for Drawing to Line an Instanding Cuspid by Screw (A).

is cut of sufficient length to extend from one of the side teeth, to which one end is fastened by means of a clamp-band, B, to the centrals, upon which it also bears. Through this strip, at a point directly off against the instanding cuspid, is made a hole in which rests a screw, S, having on one end a nut and on the other a very narrow, thin, flat ring, R, made of rolled gold wire. In operation, this ring is placed around the cuspid, when, by turning the nut, it is

---

[1] "Dental Cosmos," A.D. 1878.

drawn into line. In order to hold the ring on the tooth, a small point is soldered to its inner surface to enter a minute pit made in the tooth.

Fig. 290 represents a similar device for drawing into line an outstanding upper bicuspid, (published in 1886).[1] This

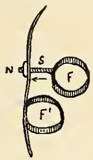


Fig. 290.—Device for Drawing to Line an Outstanding Bicuspid by a Screw (A).

differs, however, in the point that the anchor-band consists of a ferule, F′, which is cemented to the second bicuspid with phosphate of zinc. The outstanding tooth was drawn into line by turning the nut, N, on the screw, S.

Besides these I use several other modifications of the above-described devices, all of which are anchored by bands; but instead of drawing the teeth into position by means of screws, elastic rubber rings cut from tubing are placed around the teeth, and caught upon hooks soldered to a long stiff wire. See group, Fig. 163.

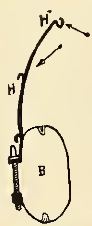


Fig. 291.—Device for moving an Instanding Lateral into line (A).[2]

Fig. 291 Mechanism for drawing into line a right upper

[1] "Dental Cosmos," March, 1886. [2] "Brooklyn Medical Journ.," July, 1888.

lateral that stood in the left posterior position, partially behind the central.[1] This tooth was first drawn from behind the central by anchoring the elastic on the hook, H, after which it was drawn directly outward to line, by transferring the elastic to the hook, H′. The application of this device is shown in Part XV., Vol. 2.

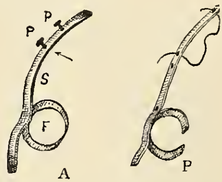


FIG. 292.—Devices for Drawing Instanding Laterals into Line.

Fig. 292 A, shows a device made in 1888, by Dr. W. H. Eames, for drawing and turning an instanding upper lateral to line. The tooth was moved by means of a rubber ring extending from the tooth to platinum pins, P, P, soldered to a strip of gold, S, serving as an arm bridge, extending from a side tooth, to which one extremity was fastened by a ferule, F, and cement, while the other rested on the centrals. The pins, P P, are made from pins taken from artificial teeth. P, shows a modification by Dr. Bonwill.[2]

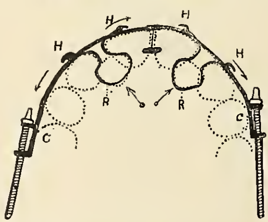


FIG. 293.—Device for Drawing into Line two Instanding Laterals (A).

Fig. 293 illustrates a device for drawing to line instand-

[1] Engraved, June, 1887. [2] Exhibited before 1st Dist. N. Y. Soc., Feb. 27, 1888.

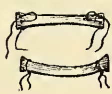
ing laterals. This consists of a long-band, C, having several hooks, H, and two elastic rubber rings, R, cut from tubing. In operating, the long-band is screwed to anchor clamp-bands fastened upon the side teeth, after which a rubber ring is caught on one hook, and carried over the top of the long-band, thence around the instanding tooth and out again over the top of the long-band, where it is caught upon another hook.[1] It will be seen that the elastics, when connected as here shown, have a triple action which forces the adjacent teeth apart, at the same time that the lateral is moving into line. The hooks are modifications of R. B. Winder's "cross-cleats."[2]

As means for drawing incisor teeth from an instanding position or for turning teeth, there are probably none more easily managed than these five devices.

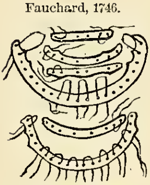
---

[1] Explained before the Brooklyn Dental Society, Feb. 27, 1888, and published in the "Brooklyn Medical Journal," July, 1888.

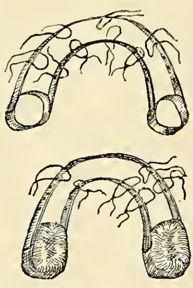
[2] The following diagrams represent several modifications of short-bands and long-bands described by the early writers, Fauchard, Desirabode, Bourdet and Harris:



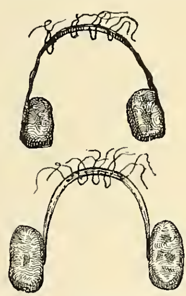
Fauchard, 1746.



Bourdet, 1786.



Desirabode, 1823.



Harris, 1850.

By making a comparison of modern short-bands and long-bands (as shown in the two preceding chapters) with the above illustrations, it will be seen that, although most of them are improvements, they all have their prototypes in these older devices. Even the principle of anchoring the short-bands by clamp-bands, ferules or clasps (as shown by M and L in Fig. 163, p. 259, and Fig. 257, p. 316) is the same, and the entire device (short-band) may be said to be only a portion of the old long-band divided about midway.

CHAPTER XXXII.

DEVICES FOR TURNING TEETH.

WIRE-TURNER.— WIRE LEVERED-FERULE.— MATRIX-WRENCH.— RIBBON-TURNER.

BEFORE closing the descriptions of apparatus, a brief chapter on turning devices will be added, but as their application is treated at length in Part XVI., Vol. 2, only the principles of the mechanisms most frequently used will be described. One of the earliest methods of turning teeth was by means of strings, so tied to the teeth to be turned that, when they were drawn over other teeth and again tied, the draught was sufficient to cause the turning. This method, though still practised by a few honored operators, is rapidly becoming obsolete, because phosphate of zinc enables us to set ferules upon the teeth with such a degree of firmness that the operation is rendered much easier and surer of success. Another early device for fixing a tooth ready to be turned was made of platinum wire so bound around the tooth that it was embraced with sufficient closeness to answer well for the firm attachment of elastics, which when stretched and tied to some other teeth were generally successful.

Wire Turner.—One form of this fixture is that devised by Dentist Hyde (see Fig. 294). This modification of Dr. Fuller's soldered coil (1872, Mo. D. Jour., p. 152) is as follows :

A piece of gold or platinum wire, five inches long, is first bent into a double loop as shown in *a b*. An excavator is then inserted at *a*, and by taking hold with the thumb and finger at *b*, the wires are twisted into a cable, as shown in *c*. This leaves a loop at *d*, of the size of the ex-

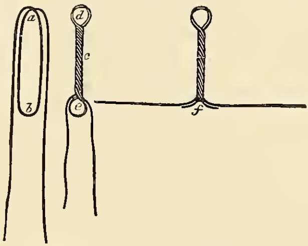


Fig. 294.—Wire Turning Device (Hyde).[1]

cavator, and another at *e*. The latter is then cut open, and the ends bent outward with the long wires as shown in *f*. The end of the cable is then soldered at *f*, to strengthen it so as to afford a strong lever. In applying this, the long wires are bent around the tooth to be turned, and then brought back to its lingual surface, where they are fastened by being twisted together by a pair of forceps; differing from Dr. Fuller's more numerous soldered coils.

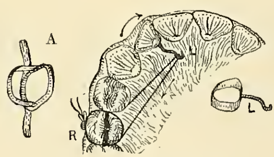


Fig. 295.—Levered Ferule.

Levered Ferule.—The device illustrated in Fig. 295 is one of the plainer forms of ferule turners, consisting of a pure gold ferule (No. 30), having a wire lever soldered to it, and is fixed upon the tooth to be turned with phosphate of

[1] "Dental Cosmos," July, 1878.

zinc cement. It can be operated by a string, rubber elastic, or screw-jack. In the illustration it is shown as having completed the turning of a right lateral with a string tied to a gum-guard ring resting on a second bicuspid. As strings must be frequently re-tied, they are not so generally used as ordinary elastic rubber rings cut from tubing, which can be stretched from the lever over any convenient tooth, or hook or other device, and carried to and caught on the lever. Sometimes a package rubber elastic ring is more practicable than a ring cut from tubing, because it can be carried several times around.[1] If there is liability of drawing the bicuspid out of place, a piece of stiff wire about the size of a pin should be soldered to the buccal side of the gum-guard ring so as to bear upon adjacent teeth. (See A.[2])

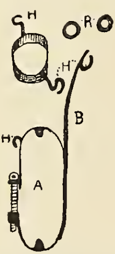


FIG. 296.—Cantilever arm Device for Turning a Cuspid (A).

Fig. 296 shows a device made for the purpose of turning a right upper cuspid. This consists of a wire-arm, B, soldered to a clamp-band, A, and a ferule having a hook on opposite sides. The tooth is turned by means of two elastic rubber rings, R, caught upon the hooks, H′ H″, on opposite sides of the bridge wire, B, thence stretched and caught upon the hooks, H H, on the ferule set upon the tooth to be turned.[3]

---

[1] Published in "Independent Practitioner," July, 1886, p. 339.

[2] Modification of anchor bar pub. in "Cosmos," Oct., 1877. (A.)

[3] Engraved, June, 1887.

Fig. 297 shows a device for turning a left upper first bicuspid by elastic rubber rings used substantially as described in the previous figure.[1] These two instruments (Figs. 296,

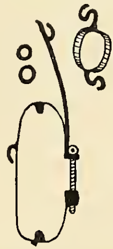


FIG. 297.—Cantilever arm Device for Turning a Bicuspid (A).

297 [1]) are probably of the best that have as yet been devised for turning teeth at a distance from the anchorage.

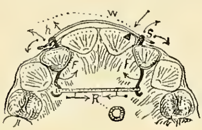


FIG. 298.—Turning the two Lateral Incisors (A).

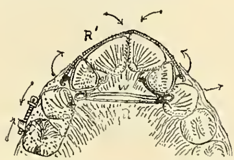


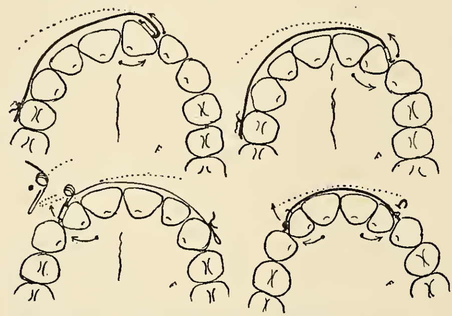
FIG. 299.—A, Reverse-acting device (A), W, wire with ring on each end, R, rubber.

Fig. 298 represents a double operation by the use of a modification of Fig. 295 for drawing out to line and turning two lateral incisors in the direction indicated by arrows. This apparatus, which is illustrated sufficiently in detail, consists of two levered ferules, F F, one of which has a staple or tube, S, and the other a hook, *h*, soldered to the (opposite sides of the) ferules for lodgment of a wire, W, as shown. The object of the wire is to draw the laterals out to line. This is attained by catching one extremity of the lever-wire under the left staple or tube, as the case may be,

[1] Eng. June, 1887. Expl. Lecture, Feb. 1888, Br'klyn Med. Jour., July, p. 31.

and then springing it from the position indicated by the dotted line so that it will catch under the hook, *h*, as shown. By this plan, in the case illustrated, the left central is used for a fulcrum. To aid this device [1] in turning these teeth a rubber ring, R, is stretched and caught upon the extremities. Fig. 299 is a reverse-acting turning device. (See Vol. 2.)

When one or both centrals stand out of line, it is sometimes beneficial to make them serve as a fulcrum by causing them to move into position by the force of the same



Figs. 300-303.—Four Methods of applying Spring Wire Levers.

operation; but when they are already in line this fulcral use is sometimes detrimental, because it not only forces them from their place, but cramps the laterals. To avoid this, all that is necessary is to so fix one extremity of the lever wire that when the other extremity is sprung down to place it will not ride upon the centrals. This is done by having two staples instead of one, or a short piece of tubing soldered to the labial surface of the ferule for the lever-wire to rest in.[2]

Fig. 300 illustrates a method devised by Dr. Angle, and

[1] From an illustrated lecture by the author delivered before the State Dental Society, at Boston, Mass., Dec. 11, 1885. [2] (Talbot's, 1884.)

consists in bending the wire so that it will enter the end of the tube opposite to the lever, as shown in the figure; the wire is then sprung from the position of the dotted line down to one of the side teeth, to which it is tied with hair-wire. Though a little clumsy to the lip, this is an excellent plan of applying the lever.[1]

Fig. 301 is a device devised by Dr. Talbot, and consists of a very small steel wire bent and coiled as shown. The coil which constitutes the fulcrum is located about one inch from one extremity, which arm is then bent upon itself, as shown in detail at the left of the figure. This is so bent, in order that when it is forced into the tube (which is made flat) it will not turn when the long arm of the lever is driven from the position of the dotted line to one of the side teeth to be tied with a string as shown.[2]

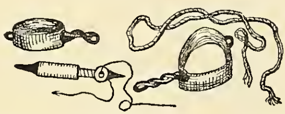


FIG. 304.—Turning Apparatus, including the Screw Jack, shown in detail (A).

Fig. 302 illustrates one of the author's old plans of applying the wire. As will be seen it enters a broad hook direct, but is so bent as to stand clear of the centrals. To prevent the lever-wire from turning, the end that rests in the hook is flattened. The hook is also flattened to correspond. This is a simple and very practicable thing, and is less in the way of the lip than the other two devices.[3]

Fig. 303 illustrates a wire acting as a double lever to move out to line and to turn the two laterals. The wire is held in place by a wire hook and a staple.[3]

Fig. 304 shows in detail an apparatus which I used

[1] Shown at a Dental meeting in Washington, in the summer of 1887.
[2] Shown at a meeting of the First District N. Y. Dent. Soc., Jan. 18, 1888.
[3] "Independent Practitioner," July, 1886.

effectively for turning the two lateral incisors of the upper jaw at the same time. The motive power was a short double spindle-pointed screw-jack. To prevent the teeth from being driven apart or forced outside of the esthetic line by the power of the screw, they were connected by a string or small wire, passed through the staples soldered to the labial surfaces of the ferules. This plan causes no pain.

In the levered and stapled ferule there is a principle which constitutes the requisite of the most efficient instruments for turning teeth. Its construction is simple, requiring very little time, and it is cheaply made. For details, as to its manufacture, see Ferules, in Laboratory rules, Part VIII.

Matrix Wrench.—Fig. 305 represents the parts of a set of detachable matrix wrenches, so called from their double utility in turning teeth and for aiding in filling ap-

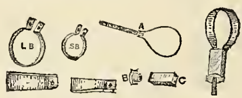


FIG. 305.—Matrix Wrench for turning Teeth (A).

proximal cavities. The device consists of a flat hoop, L B, or S B, two views of which are shown; barrel, C; screw, A; and nut, B. The figure at the right shows the appearance of the device entire.

To apply the matrix wrench, the band, L B, is placed over and around the tooth to be turned, after which it is made to hug firmly to it by the extremities of the band, (which are connected with the screw, A), being drawn into the barrel, C, by means of the nut, B. The mechanism turns the tooth by connecting the nut extremity of the screw (which serves as the extremity of the lever) by a string or a band of elastic rubber, to some other tooth or teeth. A better way is to catch it on a hook to an anchor clamp-band placed around these teeth for the purpose. The hoop should be stiff.

[1] "Dental Cosmos," October, 1877.

Ribbon.—Fig. 306 illustrates the main portions of an apparatus that may occasionally be found useful, provided it can be firmly secured around the tooth. This figure shows the device as made to be fixed to a central by means of a clamp-band, V, tightened by a nut, N, after which the base bar, U, is added and solidly rested against some of the neigh-

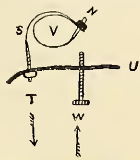


FIG. 306.—The Ribbon Turner (A). [1]

boring teeth. The device is tightened upon the tooth by the screw, S, being drawn through a hole in the bar, U, by the nut, T. While the nut, T, is causing the tooth to turn, it draws it back, if desired, at the same time. Should this latter movement be unnecessary, it is prevented by the insertion of a small screw, W, which, passing through a threaded hole in the bar, U, (only partially shown) is made to impinge against some point of the tooth or against the nut of the clamp-band. This holds the tooth in position. If required the screw may sometimes, also, be made to assist in turning, but a proper shaping of the bar by bending or filing will usually be found sufficient for this purpose. To be practicable, this device should be very delicately made.

FIG. 307.—The Ribbon and Ferule Turner (A).

A better modification, and one which gives a firmer hold upon the tooth is illustrated edge view in Fig. 307. Instead

[1] "Dental Cosmos," Jan., 1878.

of a clamp-band, this is secured by meaus of a gold ferule cemented with phosphate of zinc upon the tooth to be turned. At an opposite point on the ferule is soldered a ribbon of gold one-sixteenth of an inch in width, and as thin as writing-paper. This is hammered out of one extremity of a small screw wire as shown. Having firmly cemented the ferule upon the tooth, the screw is passed through a hole in a narrow but stiff strip of gold (only partially shown in the figure) made long enough to rest upon neighboring teeth, and then is tightened by means of a nut, which turns the tooth in the direction indicated by the upper arrow. The strip should be tied or otherwise firmly fitted in position.

As the details of construction of many of the mechanisms illustrated in Part VI., are similar, they have not been dealt with here to any considerable extent. For fuller details the reader is referred to Part VIII., which is devoted to Laboratory Rules, and in which he will find, in classified order, the method of procedure for making the different parts, such as screws, nuts, ferules, bands, etc. In the previous chapters the aim has been to give explanations of apparatus in a somewhat general way, but with sufficient explicitness, it is hoped, to enable the reader to fully understand the principles of their action, and also serve as a guide in their construction.

In Vol. 2, an effort will be made to classify the different conditions of irregularities, and to illustrate by engravings the application of most, if not all, the varieties of devices in general use at the present day. For illustration, if the treatment of irregular incisors is desired, the reader will turn to the section under that heading, where he will find all conditions of irregularities of these teeth, and the various methods of correcting them. So also in regard to the cuspids, the bicuspids and the molars.

CHAPTER XXXIII.

KEYS.

USED FOR OPERATING DEVICES.

FOR operating devices used in regulation of the teeth, several forms of keys are efficient, but generally it is better to confine the choice to one or two. These forms may be divided into three classes, the watch-key, the

FIG. 308.– Jeweller's Bench-key (Kendrick and Davis).

wrench, and the lever. Of the first, the "jeweller's bench-key," such as is shown in Fig. 308, is the most useful, because it is double, having a key at each end of the stock, differing in size. Of these bench-keys, I find it convenient to use six numbers. They can, of course, be used only on square-headed screws. Fig. 309 is an illustration

FIG. 309.—Improvised Key (A).

of an improvised key made from the stub of an ordinary watch-key, soldered into the end of a plugger socket. These stubs will be sufficiently firm, however, if roughened, and cemented in the handle with phosphate of zinc.

Larger sizes of this class of keys are sometimes necessary for turning nuts. These may be (such as illustrated in Fig.

310) made by a machinist, but a serviceable key can be made by the dentist by soldering into the handle of a plugger socket, a portion of a music-box key. When it is not con-

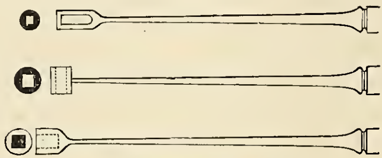


FIG. 310.—Large Size Keys (A).

venient to use solder to fix these keys into socket-handles, phosphate of zinc cement will prove to be serviceable.

Fig. 311 illustrates several keys of the wrench pattern,

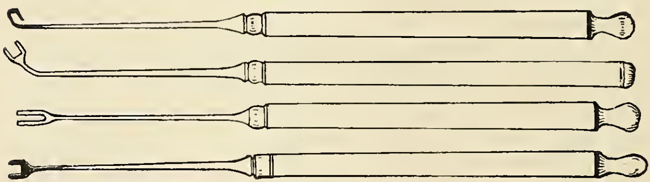


FIG. 311.—Wrench keys (A).

which may be made from old chisels. These wrenches, which should be of two or three sizes, are for turning nuts on screws.

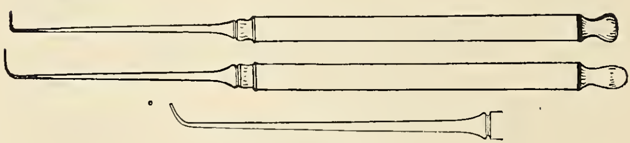


FIG. 312.—Lever keys (A).

Fig. 312 illustrates three forms and sizes of lever keys, which may be made from old excavators. Other forms will suggest themselves. The form that is midway between the straight and the right-angled, as shown in the lower portion of the figure, is especially valuable for operating screw-jacks.

Fig. 313 represents a back-action key for turning and for setting screws while the devices are in the mouth, as, for instance, where screws are used to bear against the palatine

FIG. 313.—Back-action Key (A).

walls of central incisor teeth. This device consists of a hollow handle, through which revolves a shaft having a cogged wheel at the distal extremity fitting into another cogged wheel, which turns a square key-socket for holding the head of the screw as shown in the figure.

Fig. 314 is an illustration of an expensive key made for turning screws and nuts that face the posterior portion of the mouth, such as are used in devices for drawing protruding upper teeth posteriorly, by apparatus applied inside of

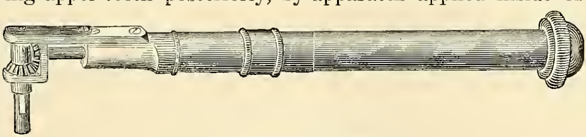


FIG. 314.—Right-angled Key (A).

the dental arch. This device is constructed simply by adding a handle and a key to a right-angled hand piece, such as is used with a dental engine. In the earlier portion of my professional career, when I used nuts that worked posteriorly more than I now do, this key was almost indispensable; but at present I rarely find use for it. The jeweller's bench-key (Fig. 308) and a set of made-over excavators (Fig. 312) constitute my principal instruments for adjusting and operating regulating devices.

PART VII.

Retaining Devices.

CHAPTER XXXIV.

UPON RETAINING DEVICES.—GENERAL REMARKS.

REACTIVE TENDENCY OF THE ALVEOLAR TISSUE.—REACTIVENESS OF THE ALVEOLUS NOT ALWAYS DETRIMENTAL.—HOW LONG SHOULD RETAINING DEVICES BE WORN?—EVIL OF OVERCROWDED TEETH.—PERMANENT AND DETACHABLE RETAINERS.—TOO EARLY APPLICATION OF RETAINERS.—IMPORTANCE OF DUPLICATE RETAINERS.

THE date of the first use of retaining devices for holding teeth in place is uncertain, but it is known that they were used by the Etruscans at as early a period as the year 750 B. C. These retainers, descriptions and illustrations of which may be found in Part II., History, pp. 33 to 36, were, however, only used to hold teeth loosened by disease; but from these it will be seen that retaining fixtures cannot be regarded as a novelty. Neither can they be viewed in the light of a luxury, but as something to be tolerated in order to prevent or overcome a greater evil. The degree of discomfort in using them, however, may be great or small, according to the skill of the operator.

In previous chapters, allusion has been made to the force shown in a tendency of teeth to return to their former position or malposition after regulation; and it was said that if prevented for a time by retaining devices this tendency will be broken. The possibility of overcoming this tendency of the teeth to retrace their steps after being regulated may at first seem to be true of only the alveolar tissue, but the subduing of the natural tendency to maintain normal form is shown also in other members of the body. If a person habitually stoops, he becomes "round-shouldered." Feet confined in narrow shoes undergo changes of form corresponding with the pressure of the shoe, and, although shoulders and feet are at liberty for nearly half of the twenty-four hours (while asleep), the result of the force during the other half is not entirely lost, thus showing that although there is a law of nature that tends to restore the original shape, this law is not sufficiently powerful to withstand indefinite opposition, even if only periodically applied. The scientific regulator, however, does not recognize simply the occasional use of retainers, but regards their continual use to be of great importance; in order that the molecular changes in the tissues shall have time to properly take place as speedily as possible.

Reactive nature of the Alveolus not always detrimental.—This disposition or tendency of teeth to return, is generally viewed as an unmitigated evil; but when looked upon in a wider sense I think it is one of the most valuable aids to the regulator, for, owing to this tendency, or, more properly speaking, to the temporary disposition of the elastic quality of the socket tissue to readjust itself, those teeth which are accidentally or necessarily obliged to be forced beyond or out of their proper positions, during the process of moving other teeth, whether these be the teeth we desire to move or others, will easily adjust or re-correct themselves upon the removal of the force, thus saving the operator much anxiety and trouble. Besides this, by taking advantage of such tendency of the socket tissues he can carry on his operations with much less risk than would otherwise be possible. Owing to this systemic characteristic, all that is necessary in order to even the line of arch after some of the teeth have been moved too far outward is to cut away the retaining plate at points off against these teeth, when they will fall back to the plate and thus be in line.

What length of time to wear.—A dentist who has attained considerable eminence in various directions says that, "After the teeth have been made to assume their proper places, in the majority of cases, they do not need even a silk ligature to hold them there; the resiliency of the lips and the occlusion of their opposing teeth will keep them in position." This is true of small children, but in older cases it is not in accordance with my experience.

It should be stated, however, that there are exceptional cases in which adult teeth will remain in place, without artificial support; such as when the antagonism is favorably arranged to "hold them as in a matrix," but such antagonism is not often found.

In cases in which certain teeth have become very loose, and in which but little ossification of the supporting tissue takes place, it may be impossible to retain the teeth firmly in position by any means. Such instances are often found to be the result of bungling attempts at regulating with elastics and strings, which have repeatedly ploughed deeply beneath the gums, or have slipped off many times, occasioning a corresponding number of backward and forward movements, resulting in a disease of the sockets, resembling in some degree loculosis alveolaris.

The old-fashioned mechanisms, large and clumsy, are not only inconvenient, but are seldom necessary, because nearly every variety of cases can be managed equally well, if not better, by delicate fixtures that reduce the inconvenience to a minimum.

The length of time necessary to wear retainers may be said to vary from three weeks to three years, or even more; but however inconvenient their use may be, more harm is done by removing them too soon than by wearing them too long. Of course, they must be kept scrupulously clean, and should be made with this end in view, so that however long they may be needed, the results that would follow uncleanliness may be avoided. It would indeed be careless practice to use a device that, by difficulty of cleansing, might destroy the teeth it was intended to benefit.

Evil of overcrowded Teeth.—Before retaining devices can be of permanent advantage, it is important to take measures, while regulating, for relieving an overcrowded condition of the teeth. If such condition exists, and is allowed to remain, it matters not how long the retainer is worn, the teeth will not stay long in their proper places after it has been removed. This is the reason why many cases in the end prove failures. The necessary space may be secured by widening the arch sufficiently to accommodate the teeth, by extracting some of them, or by adjusting the antagonism so that the lock will hold them in place. Nor is overcrowding of teeth the only evil to guard against, for, in the relation of the lower anterior teeth to the upper lies much of the cause that prevents permanency of success in the correction of protruding teeth. If the lower teeth press against the lingual walls of the upper teeth the latter are sure to be driven forward again whenever the retaining device is dispensed with, even after it has been worn for years.

While the permanency of successful correction of irregularities depends much upon securing for the teeth freedom from overcrowding, the length of time necessary to wear retainers is also governed by the age of the patient, stage of development of the teeth, their number and position in the arch, and the relation they bear to the opposite teeth. While a few days will suffice for a child, in whom the roots of the teeth are not fully developed, whose alveolar tissues are soft, and in whom the molecular changes are rapid, months and even years may be necessary for adults, in whom the teeth are fully developed, the bones hard, and molecular changes slow. In cases of inherited deformity, as has been said in previous chapters, the natural tendency to irregularity is so strong that the time may never arrive when it is safe to discontinue wearing the retaining device; but to advise the wearing of a retainer for a lifetime to hold teeth in place that have been regulated, without exercising the care that has been recommended as to relieving an overcrowded condition, or to prevent improper antagonism, is wrong. The apparent necessity of wearing a retainer permanently is a matter that should not be lightly determined. To avoid such a necessity, the first requisite is to do away with the overcrowded condition, even if it be only slight. By the term "overcrowd," I do not mean simply contact. Teeth that are in contact are not necessarily overcrowded. But where, by neglect, a really crowded condition has been permitted to remain, it may render re-regulation necessary, as well as the wearing of a retaining device for years. Even then, as before said, there is no certainty that the teeth will not return, at least in a measure, to their old positions, when the restraining influence of the device is removed. Failures occurring from negligence on this point of overcrowding are frequently attributed to heredity or family type, a "theory" which may satisfy the patient, but ought not to satisfy the practitioner.

But even in cases where heredity, or other conditions that cannot be overcome, render it necessary that regulation should be followed by wearing a device during life, I would not advise against regulation, for the disfigurement caused by irregularity may be of such a character as to make the use of artificial means to retain the teeth in place, even for life, more endurable than continuance of the deformity. Like a delicate plate for supporting an artificial incisor to supply the defect from loss of the natural organ, a retaining device may be so made that it can be worn with little or no discomfort or injury, provided it is kept clean. For such cases the long use of retainers should not be discountenanced, since they are for overcoming deformity quite as great as that from loss of a tooth.

Even in ordinary cases, where the operation has been scientifically performed, yet requires the wearing of the retainer for a long time, an appeal to the pride in personal appearance, and a hint as to the trouble of repeating the regulating process, if it is removed too early, is generally sufficient for intelligent patients, for they are usually more willing to wear such a retainer than to run the risk of being disfigured for life. In this matter, of course, children are not always able to appreciate the advantages derived from correction of these deformities, and must be controlled by their parents or guardians.[1]

Permanent and Detachable Retainers.—When retaining devices are removed for cleansing, they should immediately afterward be returned, for, if not, the teeth may begin to move out of place, thus requiring to be forced back again. Such alternations of movement of the teeth back and forth, as before said, greatly retard the development of the supporting tissue so necessary to hold them in their new position. It therefore becomes evident that if it is possible to permanently fix a retainer upon the teeth, so that it will serve the purpose and not injure them, it is better to do so than to use a detachable one. This implies the use of small and delicate skeleton fixtures which can be kept clean, such as are made of flat or round wire anchored into cavities or soldered to a ferule cemented to the tooth or teeth that have been moved or to those adjacent. It is a noticeable fact that teeth, which are cemented into properly-made ferules are less liable to injury than those teeth on which detachable ferules rest. To leave an uncemented band for a long

---

[1] See Retaining Teeth in Position, in Part XX. Vol. 2.

time upon a tooth, especially if it be in a young person, without removing it frequently to cleanse it, would be very liable to cause injury. I have known even linen threads worn for a long time as a means of retaining teeth, to cause white lines in the enamel.

While clamp-bands should not be bound too tightly on the teeth, when they are to be worn as retainers for several months, yet as a means of anchorage for correcting devices, this may be safely done during the time that is necessary to regulate the teeth; for in such operations, even if considerable time is used, the constant necessary changing or modifying of the fixture is generally sufficient to permit a release of the strain upon the tissues by some slight change of position. But a ferule, skillfully made and properly set with phosphâte of zinc, though tight upon the tooth, does not bind it at all, therefore it is harmless even if allowed to remain a long time. Conditions that are favorable for permanent retaining devices are not often present; therefore the detachable kinds are more generally used. Teeth that become injured by any properly-made retaining device, however, only prove that uncleanliness and neglect are habitual with the patient; habits that I am forced to admit are too common even in what is called good society. As an illustration of this carelessness, I will mention that at one time I took from the mouth of a country gentleman a detachable partial gold set of artificial teeth that had not been removed for a year and a half. At another time I removed for a city woman of high social position a partial set that had not been taken out for four months. Both of these dentures had become considerably buried in inflamed and congested gum tissue. If such carelessness could exist in the cases of "society people," what may we expect of those called the "lower classes"?

Too early Application of Retainers.—Retaining devices are sometimes applied too soon after the teeth are regulated. The effort to regulate teeth quickly, so as to be rid of the case as soon as possible, has led to many difficulties, besides torturing patients. In fact, most failures may be directly or indirectly attributed to this haste, especially in cases where a powerful kind of apparatus that was necessary to move the teeth has been taken away too soon, and weak and insecure retaining devices substituted for it. As a rule, (not in cases where the roots are only partially developed,) I think that when practicable such teeth should be held in place for a week or two by the same apparatus that moved them, before the proper retaining device is applied, because the regulating fixture is (generally) sure to be strong enough to hold the teeth stationary.

The longer teeth are held in position, the less power there is left in the tissues to cause them to return. This diminution of power is probably in part, if not mainly, due to the new tissues taking on conditions that are physiological to the situation, in place of the perverted conditions caused by the pressure.

In other words, the new cells which supply the place of those which have broken down will be developed according to the conditions of the environments, so that the tissue will not continue to have the disposition to return to its original form. It may be said that in proportion to the re-development of new cells and new tissue will the reactive tendency diminish; and as soon as the last old cell is gone and the new one takes its place, provided, as before said, there is no overcrowding of the teeth and the antagonism is proper, the wearing of mechanical retainers may be said to be unimportant. There is one condition, however, that should be excepted, namely, where there is too much room and the teeth stand isolated and tend to move laterally. The behavior of such teeth can never be depended upon, unless held in place by finger-shaped devices or wart-plugs.

Duplicate Retaining Devices.—When a patient who has had teeth regulated intends to travel or to be absent for a considerable length of time, prudence suggests that a duplicate retainer made upon the same cast be furnished to the patient for use in case of breakage or loss of the original one. At least the operator should preserve an accurate cast of the teeth, upon which another device can be made at short notice. The latter plan is not as practicable as the former, because if a new one be sent to the patient, it may not fit properly, owing to movement of the teeth resulting from loss of the first retainer. To allow a patient to go abroad with only one retaining device, is almost unpardonably careless, because by the loss of the retainer, the teeth, having their liberty, are very liable to again become irregular. Many successful operations have ended in failure because of this neglect. Patients should be taught the importance of wearing retainers continually, and cautioned against leaving them out of the mouth an hour under any circumstances, while travelling.

After teeth are regulated, and the retaining device is inserted, the case should be inspected from time to time to insure that the teeth remain in position. This is because retaining devices may not always bear correctly at all points; slight pressure in the wrong direction will cause teeth to move out of place. After two or three examinations, if there appear to be no detrimental influences upon the teeth, it is not necessary to see the case often; still, the patient should not remain away longer than a few weeks or months for the first year at least, because the accidental bending of some portions of the device may do great harm.

Recurrence of Irregularity from continued Eruption of Teeth.—Occasionally it happens after a case has been properly corrected, even after the retaining device has been worn, that some of the teeth go a little astray. This mal-influence does not always exist at the time the case is regulated, but is sometimes the result of changes in the antagonism brought about by eruptions of later teeth. It may occasionally be caused by the continuation of the eruptive process of some of the teeth already present. For instance, the cuspids, which at the time of operation are often only partially developed, not only tend to force other teeth out of place, but may move themselves out of place also by the same crowding force. To remedy this, it is sometimes necessary to readjust them ; but often it is better, when irregularity is occasioned by interfering points of improper antagonizing teeth, to grind such interfering points away, after which the strayed teeth will generally fall back into line again. The extent of grinding necessary, however, if done at one time, may cause sensitiveness ; therefore this operation should be carried only so far in one season as will be safe. (See Part XII.)

Case.—This may be illustrated by a case in which the teeth became irregular after the operation. The patient was a young lady for whom I had regulated teeth about five years before. The teeth remained all right for four years from the time they were corrected and until within the past year, when, to the astonishment of the patient, the upper right cuspid was found to be moving outward more and more. When the case was seen the tooth had moved about one-sixteenth of an inch. This, in effect, caused the lateral to take a slightly posterior position. Examination and biting upon marking paper showed that this tooth occluded with the lower cuspid, which also had moved inward from the same cause. The lower cuspid was ground as much as was prudent, until the teeth were fully freed from contact, though not separated as far as they needed. The case was then allowed to rest for several months, when the teeth were again in contact. The operation was repeated and the case rested the second time. In the course of a few months the case was again examined. It was much improved, but the teeth were not quite in line and the cuspids were again in contact. They were ground once more, the lower tooth on the top and outer face; the upper on the lingual surface. In this way, by simply grinding away the interfering points, the teeth were regulated without causing sensitiveness of the dental tissues.

Another case, a relative of the last-mentioned patient, whose teeth had been regulated by a dentist of some eminence, came under my care, suffering from dental caries. For five years her teeth appeared overcrowded, yet the only disfigurement was a slight outstanding of the upper cuspids. In the sixth year I noticed a disposition of the laterals to move outward and the cuspids inward. Six months afterward, the laterals having moved sufficiently to allow the anterior corners to pass the corners of the centrals, they (the laterals) rapidly moved forward, each overlapping the centrals about one-sixteenth of an inch, while the overcrowded outstanding cuspids, the crowns of which previously stood slightly inclined, wedging their way in, soon moved to line, and stood in the correct position.

CHAPTER XXXV.

SMALL RETAINING DEVICES.

THE varieties of apparatus that have been devised for retaining purposes and the plans of their construction are somewhat numerous, yet the principles in all are few. One of the simplest devices used by some operators consists of strings or of small wire twined around and between the teeth in a manner resembling the form of the numeral 8 (Fig. 315). This plan, however, is very uncleanly, and can-

FIG. 315.—Hair Wire Retainer.

not be regarded as safe, nor is it an improvement upon the Phœnician method practiced several hundred years before Christ (see Fig. 9, p. 35). Such retainers are always a nest for decomposed food and bacteria, and a source of foul breath.

Multiple Ferules.—Another class of devices involving the same principle, constituting one of the most simple and effective kind of retainers for holding teeth that have been turned into position, consists of a ferule (having partitions) made large enough to embrace two or three teeth, as shown by B, and B′, Fig. 316,[1] or better, two or more small ferules soldered together, as shown by F and F′, Fig. 317.

[1] Devised in 1886.

There appears to be some doubt as to the priority of the latter form of device; the evidence seeming to be that more than one person conceived the plan at about the same time. Among the earliest, if not the first, to use a multiple cap

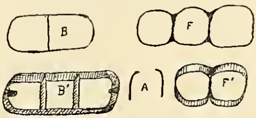


FIG. 316.—Partitioned Ferule (A).
FIG. 317.—Multiple Ferule Retainers

as a retaining device, of which the multiple ferule is a modification, was Desirabode in 1823.

These ferules, as I make them, are of pure gold, No. 32 to 34, soldered with 18 k. solder, over an ordinary spirit office-lamp. When completed they are placed upon the teeth, and the edges bent over, in places as in A, and then they are removed, dried and reset upon the teeth with phosphate of zinc. Sometimes these may with safety be allowed to remain for several months, possibly a year; but in order to insure cleanliness and safety of the teeth they should be watched. As the cement disintegrates in the secretions, they generally require to be occasionally reset with fresh cement. To prevent accumulation of food about these ferules, their edges, especially those for single teeth, should lie close to the necks, sometimes extending up to or even a short distance under the free margins of the gum, but not far enough to cause injury to this tissue. The close relation of the band to the tooth and gum is an important matter in order to prevent accumulation of injurious *débris*. As the placing of the edge of any ferule under the edge of the gum is liable to cause irritation and inflammation, this feature, in all operations in which ferules are used, whether for this purpose or for crowning roots, must be regarded as a drawback that should be looked upon as a point or consideration of no slight importance.

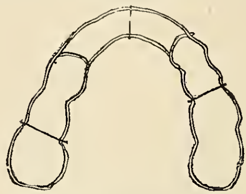


FIG. 318.—Wire Crib-Retainer.

Detachable Wire.—A plan was suggested several years ago (I think by Dr. W. H. Atkinson), of holding the teeth by large wire laid along the outer and inner surfaces of the dental arch. The wire was bent to rest along close to the lingual wall of the teeth, thence around and along the buccal or labial walls, the inner and outer portion of the wire being connected by cross-pieces of similar wire, or by thin strips of plate, substantially as shown in Fig. 318. This device, which for some cases is very useful, should be made of stiff gold, or platinum, carefully fitted to a perfect metallic cast, so that when it is applied to the teeth it will "go home" and rest with ease. As such retaining devices are delicate, the patients should be instructed to exercise great care in removing them to cleanse the teeth.

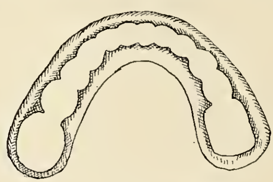


FIG. 319.—A Hard-rubber Retainer.

Hard-Rubber.—Fig. 319 illustrates a hard-rubber retainer that I made in 1873 for holding in position lower teeth which were made very loose by loculosis. Unless this device (which is in reality only a modification of Dr. Atkinson's retainer) is made very delicately, it is a clumsy affair, and is only to be recommended on account of its rigidity and cheapness. When teeth are missing, I sometimes attach artificial crowns to the same device as a substitute for them. The appliance should be removed after every meal and cleansed. To hold the teeth firmly it ought not to be made so thin that it will lie loosely about the necks of teeth after it has passed over the crowns, (which are larger than the necks,) but should be thick enough to extend sufficiently high to embrace the crowns. Several years ago, and perhaps before this one was made, Dr. Richardson devised a similar instrument made of two pieces of hard rubber, one to fit the outer surface of the dental arch, the other the inner surfaces, which were united through vulcanization by cross-pieces of wire or plate, substantially the same as shown in Fig. 318.

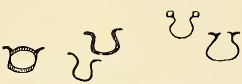


FIG. 320.—Small Retaining Devices (A).

Miniature Retainers.—Fig. 320 illustrates a group of small devices for temporarily retaining the incisors singly. These are made of narrow strips of gold plate or rolled wire, so cut and bent as to extend around the tooth that has been moved into line, the extremities resting upon the adjacent teeth. These devices may be open like the letter U, with ears or lugs on the extremities, or they may be closed in the form of a ring, having ears soldered to the side. Both of these patterns are shown in the figure. The drawback to these devices is that they will not remain firm upon some teeth that are tapering.

Fig. 321 is an illustration of the H-retainer, which occasionally is found useful for temporary purposes. This device may be made of two U-shaped strips of flat gold (plate) about one-eighth of an inch in width, soldered together at

Fig. 321.—H-retainer.

their backs, or it may be made of two straight strips soldered midway to the ends of a third strip, as shown in the second figure. To hold an instanding incisor that has been drawn into line, this is placed low down on the sides of the tooth and then bent to rest upon it and the adjacent tooth in such a manner that it will bear on portions of their necks and, extending over some prominence on the enamel, rest on a less prominent place.

Fig. 322.—T-retainer (Guilford).

Fig. 322 is a device of Dr. Guilford's for holding two centrals in position that have been turned. It is made exactly like his device for turning such teeth. When in use the middle piece rests between the incisors, while the extremities extend around the opposite sides of the teeth and hug them in a manner that prevents them from turning. To fit this device so that it will rest firmly is, however, a nice operation, but if the teeth are of favorable shape it is very practicable.

Fig. 323.—Yoke-retainers (A).

Fig. 323 illustrates three devices made to be tightened upon the teeth by means of very small (transversely arranged) screws and nuts. These are somewhat difficult to make, but occasionally they are very useful. Their construction is so clearly shown that is is not necessary to explain them, further than to say they should be very delicately made.

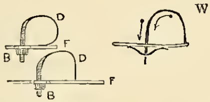


FIG. 324.—Screw-retainer and Anchor Device (A).

Fig. 324 illustrates two sizes of an 18 k. gold instrument suitable for two purposes, retaining and anchoring, which was published in 1877.[1] This consists of a small screw, having a ribbon, D, soldered at one end to a thick but narrow strip of plate, F; the screw at the other end passes through an oval hole in the thick strip, where it is fastened by a nut, B. This ribbon and screw may be made of one piece of wire, or the two parts may be soldered together. If made on the former plan it is much stronger. The adjusting feature of this device is the oval hole in the bar. When desired for anchorage purposes, a small ring should be soldered to it, to which the other parts should be hooked. W, is a spring modification by Cecil P. Wilson, 1888.

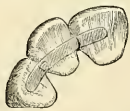


FIG. 325.—Screw and Loop-retainer (A).

Fig. 325 illustrates a retaining device similarly made to the above for temporary purposes (published in 1879),[2] differing from it, however, in this : instead of soldering one end of the ribbon to the thick strip, it is caught around it by a

[1] "Dental Cosmos," Oct., 1877, p. 520.

[2] "Dental Cosmos," Feb., 1879, p. 75.

rectangular wire loop, as shown. The adjustable feature of this device is the rectangular loop at one end of the ribbon, which plays on the thick strip of gold. These devices are sometimes valuable, but for general practice they are no better than a ferule and a piece of wire soldered together, as shown in the following figures. Such retainers should not be allowed to remain long without cleansing, as food will collect under them and injure the teeth.

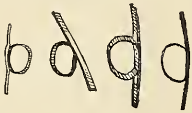


Fig. 326.—Armed Ferule-retainers.

Armed Ferules.—Fig. 326 illustrates different modifications and sizes of small devices for retaining single teeth. These consist of thin gold bands, one-sixteenth of an inch in width, having one or two arms made of a strip of plate or a piece of platinum wire soldered to each. In use, these bands are driven upon the tooth after the arms are adjusted to bear properly upon the adjacent tooth or teeth. They cannot be used on teeth that taper much in shape. A firmer device is made by having the ferule portion somewhat larger than the tooth, and then cementing it upon the tooth with phosphate of zinc, as suggested by Dr. Magill in 1871.

Priority in originating a closed band and such attachment is said to belong to several persons, among whom the author is included : but, although it was invented by each one independently of the other, who was the first to solder a strip of plate to a band, as here shown, I have not ascertained.[1]

[1] Dr. Guilford used one in Dec., 1880. I published in the "D. Cosmos," Oct., 1877, an open band with a bar. A band having a small knob soldered to it for attachment of strings is implied by C. A. Harris in his work, 1839, p. 108, and mentioned in the edition of 1850, p. 150. This device has been later reproduced as *original* by several dentists.

A serious objection to all loose bands is the danger of *débris* collecting under the band and injuring the tooth.

FIG. 327.—Ferule and Detachable Wire Arm Retainer.

FIG. 328.—Tubed Ferule and Detachable Arm Retainer as Applied.

Fig. 327 illustrates parts of similar devices, modifications of those preceding, differing from them in that the ferules are much broader and the arms are detachable and are held in place by two staples, A, B, or by a short piece of small tubing, C. These staples may be made of round or flat wire, and the tubing of a piece of plate rolled upon itself, or cut from jewellers' "hollow wire."

Fig. 328 shows this device, C, entire, holding a lateral which has been drawn from a posterior position into line. To whom the priority of use of the staples on such regulating devices belongs is uncertain: the author published them in 1886.[1] Probably the first to use the tubing on a ferule was Dr. Talbot in 1884.[2] Dr. Angle claimed it in 1886–7.

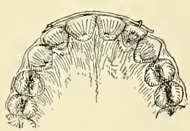


FIG 329.—Stapled Ferules and Long Detachable Retaining Wire as Applied (A).

When two instanding lateral incisors have been forced into position they may be temporarily retained by a wire extending across the anterior walls of the centrals, the ends

[1] "I. Practitioner," July, 1886. For tubing see "Dental Cosmos," July, 1886.

[2] See "Irregularities of the Teeth," by Talbot (1888), p. 139.

resting in staples soldered to the labial surfaces of two such ferules, as shown in Fig. 329.[1]

I have, by means of the elasticity of the same device, drawn instanding laterals into line, but, unless the force is applied lightly, this process is generally attended with some pain.

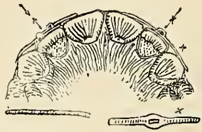


FIG. 330.—A Double and Single Stapled Ferule with two forms of Detachable Retaining Arms (A).

Fig. 330 illustrates two modifications of stapled ferules and two forms of retaining arms as applied for retaining, independently, individual teeth. The device on the (patient's) right shows a ferule having two staples, with a piece of round wire passing through them, and on the left a ferule with a single staple turned the other way to hold a narrow strip of plate by passing through a hole in its middle portion, x, x. It is then pinned. Both of these devices are so unsightly and so difficult to keep clean that they are recommended only as temporary resorts while other teeth are being regulated.

The above figures show how such devices are made for and applied to anterior teeth, but such wires extending from bicuspid or molar ferules are equally useful.

Opposite Wires soldered to Ferules.—Besides fixing retaining wires independently to anchor ferules, a very useful and convenient plan is to fix one end to the ferule by sol-

[1] From an illustrated lecture, delivered before the Massachusetts State Dental Society, at Boston, Dec. 11, 1885; published in "Independent Practitioner," July, 1886.

der and then shape it to such a form that the wire will reach out against the tooth to be held in place. Of course, it should be remembered that the force upon the wire, exerted by the tendency in the regulated tooth to return to its former place, must be guarded against, in order to prevent the anchor teeth from moving. When this is liable to occur, which is not often the case, it is easily obviated by the addition of another wire, so arranged as to bear oppositely.

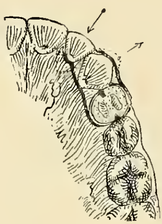


FIG. 331.—Counteracting Retaining Wires anchored to a Ferule (A).

For further illustration of this principle take a case such as shown in Fig. 331, where it was necessary to retain in position a cuspid and lateral incisor that had been moved into line from abnormal positions. Having made a ferule to fit the first bicuspid, one end of a piece of wire of sufficient length to extend from it (first bicuspid) and projecting forward, escaping the lingual surface of the cuspid to bear upon the incisor, was soldered to the ferule, after which another piece of wire of sufficient length to bear upon the labial surface of the cuspid was also soldered to the ferule, as shown.[1]

[1] Lecture delivered in 1885; published in the "Independent Practitioner," July, 1886.

If the ferule is made wide enough to include the entire crown, and is properly fitted and set like a gold thimble-crown, it may remain several months without harm.

Wires fixed in Cavities.—When opportunities present themselves for anchoring retaining wires in cavities in the teeth, (which is not often,) I have found them very practicable. In making them they should first be bent so that the other end will properly bear upon the regulated tooth. When such a wire requires rebending after being once fixed upon the teeth, it should be of platinum, because having less elasticity it will rest where it is desired; but if rebending is not desired, the device is more satisfactory to the patient if it is made of gold.

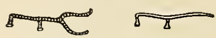


Fig. 332.—Cavity Wires (A).

To give great firmness of anchorage, a branch or foot wire from the main wire should extend into a cavity in another tooth. Two forms of such wires are illustrated by Fig. 332.

Fig. 333.—Cavity Wires (A).

Fig. 333 illustrates one of my favorite methods of retaining teeth on this plan. In this case a branch wire is soldered to the main wire to counteract the force of the lateral incisor, but in most cases it is not necessary. The anchor leg wires are first roughened and headed, and then are cemented into the cavities with phosphate of zinc, for which amalgam should be substituted one at a time at different sittings in order to make their retention more durable. The object of changing only one filling at a sitting is to enable the amalgam to harden, in order to avoid the danger of loosening the wire.[1]

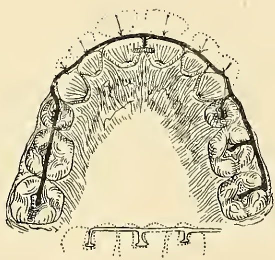
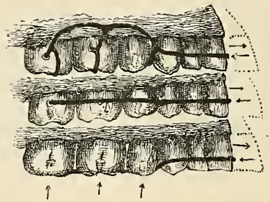


FIG. 334.—Long Retaining Wire anchored into Cavities (A).

This plan on a larger scale is occasionally practicable for retaining *protruding* front teeth that have been *regulated*, but it requires great care on the part of the patient in order to maintain cleanliness. The extremities of a long piece of wire about the size of a large pin (having, if necessary, a T near its middle point, to rest between the incisors to prevent it from impinging upon the gum), is anchored in two or more cavities in the grinding surfaces of the bicuspids and molars. Fig. 334 shows such relation of this wire to

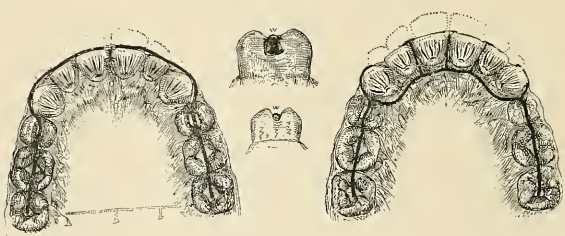
[1] See note 1, p. 372.

the teeth, as seen from the inside of the mouth. The diagram in the lower portion of the figure shows the method of its anchorage into cavities.



FIGS. 335, 336, 337.—Permanently anchored Wire Retainers (A).

The firmness of these long wires may sometimes be increased by having branch wires extend from them into other cavities wherever they may be, substantially as shown in Figs. 335. 336. Probably the best of these plans and the strongest is the one illustrated by Figs. 337 and 338.



FIGS. 338, 339, 340.—Permanently anchored Retaining Wires (A).

Fig. 339 shows how the wire rests in the sulci of the teeth. The conditions necessary to the use of such branching wires, however, are seldom present; consequently if they cannot be made to rest sufficiently firm, their employment should not be attempted. The same criticism is applicable to all kinds of fixed retaining devices, as to fixed dentures. They are difficult to keep clean. Therefore they should never be used except by patients of cleanly oral habits. As a rule it may be said that although it is important that regulated teeth should be held firmly, retaining fixtures should generally be made so that they can be easily removed and cleansed.[1]

FIG. 341.—Retaining Wire for Corrected Protruding Teeth anchored to Gold Thimble-crowns (A).

Wire fixed to Thimble-crowns.—Fig. 341 shows another and a superior plan of retaining corrected protruding teeth.

The plan consists in soldering the retaining wire, W, to gold thimble-crowns, C, C. For cases of retention this plan is one of the most unique and reliable. These thimble-crowns are fixed to the crowns of the teeth by phosphate of zinc.[2]

Another plan of holding corrected protruding teeth in place is to rest the extremities of the long wire in miniature ferules soldered to the buccal sides of the tooth ferules. The wire is held in place by small thumb-screws, after the Patrick method of holding the long-band. This, however, does not often afford satisfactory firmness.

[1] "Independent Practitioner," July, 1886. [2] The principle of this device is shown by Desirabode, 1823; also by Harris, 1850. "Principles," p. 162.

CHAPTER XXXVI.

RETAINING PLATES.

ROOF PLATES.—RIBBED PLATES.—PATCHING OUT PLATES.—TYING PLATES WITH STRINGS.—SKELETON RETAINERS.—CANTILEVER THIMBLE CROWNS.—SPLINT RETAINERS.

RETAINING plates may be full or partial, according to the offices that they are to fill. When it is only desired to hold teeth in place that have been moved outward, whether they be few or many, the simple roof plate, made as shown in Fig. 342 is very efficient.

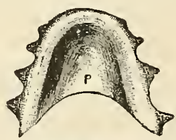


FIG. 342.—Roof Plate.

Ribbed Plates.—Plain roof plates may be made of gold or silver, but hard rubber is preferable. Having obtained an accurate cast of the teeth, gums and roof of the mouth, the back part of the cast (corresponding to the posterior portion of the hard palate), where the posterior border of the plate is intended to rest, should be slightly scraped, especially where it represents the fleshy portions between the median line and the alveolar ridge. This is in order to have the plate lie close to the tissues. If no auxiliaries are to be used, such as clasps or bands to hold the plate in place, it is further necessary to scrape a slight groove close along the necks of the teeth of the casts, so that the rubber will flow into it, and make a ridge that will extend slightly into the gingival trough. The object of this very useful rib (the name of the originator of which I have never heard), is to bear against the necks of the teeth at the highest possible point, and where (generally) the tooth is smaller than the crowns. This plan, which is illustrated in Fig. 343, will sometimes give a degree of firmness that will hold the plate in place without other aids. Occasionally, however, addi-

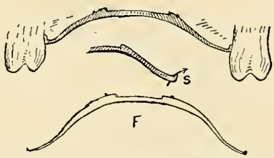


FIG. 343.—Section Views of a Rubber Retaining Plate, showing Ridges.

tional aid may be derived from a chamber, and also from a "scratch rib," sometimes called "Folsom's ridge," extending around it (illustrated by black dots near the chamber). Another scratch rib near the posterior border of the plate, say about one-sixteenth or one-eighth of an inch from the edge, is serviceable.

Shaping the Plate.—The shaping of the plate as regards thickness is a matter of considerable skill, requiring some knowledge of "strength of materials," such as is required in building masts for ships. While the middle portion of a plate should be somewhat thick, it is generally unnecessary along its outer portions. This thinning-out is also requisite in order to avoid clumsiness. In a large majority of cases this may be carried so far as to make the edges as thin as a visiting card, but extreme thinness is only proper where the rib is unnecessary. This shape is shown in section by F, in Fig. 343. In making a top-mast the largest part is not at the base nor at the tip, but the portion near the middle ; this renders all parts of the mast equally capable of withstanding the winds. The same philosophy is applicable in the construction of plates for the mouth. A plate that is properly made—thickest at the middle portion, thinning out toward the free margins—although more elastic, is less liable to break than if made equally thick in every part.

The anterior portion of a roof plate for retaining corrected protruding teeth should be cut away, so that the lower anterior teeth will not press upon it, as this force tends to push forward and outward the anterior portion of the alveolar ridge, and in so doing to cause the teeth to retrace their steps and bring back the deformity. When, however, it is necessary to cover the entire roof of the mouth, and it is not possible to make a hard rubber plate thin enough, this portion of the plate may be made of gold ; but it is seldom necessary. Carelessness as to this point, by allowing the lower incisors to strike the plate, has led many cases to return to the original condition, and the operations have been pronounced failures. When it is impossible to prevent this bearing by any other plan, gold thimble-crowns placed upon the molars will prove successful.

Patching out Plates.—Sometimes it is necessary to insert a retaining plate before all the teeth are regulated. When a tooth has been moved away from a plate by some other instrument, it (the plate) may be exchanged for a new one, or the old one may be patched out by vulcanizing more rubber to it. But instead of doing either, an arm-piece made of gold plate, riveted to the plate so as to extend from it and impinge against the tooth or teeth moved last, is often practicable. Fig. 344 shows such a modification, which was improvised in about twenty minutes. The best rivets for this purpose are platinum wire. I generally use pins obtained from porcelain teeth by crushing them.

Tying Plates with Strings.—Some operators resort to the aid of strings for holding plates in place. If plates are to be held by strings, the dental periphery should be of considerable thickness, and the holes through the plate for the

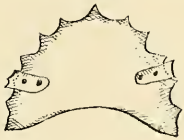


FIG. 344.—Patched Roof-plate.

strings should enter at a point about one-sixteenth of an inch or more from the edge on the lingual side, and open out at a point close to the surface of the teeth on the palatine side at the angle of the plate's edge. This is indicated by an arrow through a portion of a plate, S, shown in the middle part of Fig. 343. By it we are able to place strings high up on the neck of the tooth. The plan of tying regulating plates in place by strings, so much followed by some operators, although practicable, I think for any other than temporary purposes should not be encouraged, for at best such plates cannot be very firm.

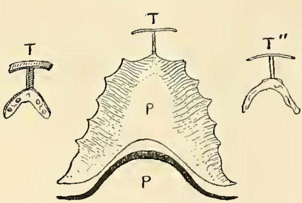
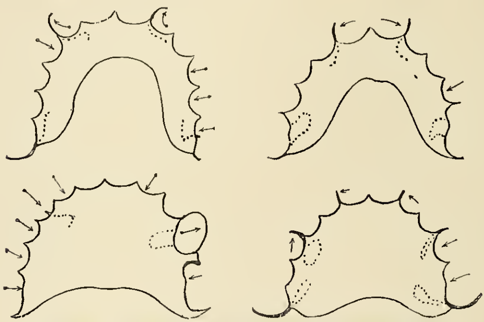


FIG. 345.—T-Roof-plate for holding protruding Centrals in Position.

Another old and well-known device for holding corrected protruding central incisors in place is a roof plate having a gold T fixed into it, to extend between the teeth. This device is illustrated by Fig. 345. The same drawback exists in this plate as referred to concerning those worn for corrected protruding teeth, but it can be overcome in a similar manner by making the anterior portion very thin or by cutting it entirely away. The T-piece is made as shown in detail T′ T″ in the figure.

Finger retaining Plates.—For holding individual teeth in place after having been drawn into line, there is nothing



FIGS. 346, 347, 348, 349.—Various Modifications of Retaining Plates.

more practicable than some form of rubber plate having clasps, or narrow bands to embrace such teeth. Of course the shape of these appendages to plates must depend upon the nature of the case. As a principle of construction, however, the plate should bear along the lingual walls of the side teeth, and to hold it in place must depend upon the conformation of the crowns or upon the clasps or rings, or both. Where several teeth have been moved from outstanding positions into line, and some of them have also been turned in their sockets, flat wires anchored to the plate and reaching out between some of the teeth and bent so as to bear upon those that have been moved, is probably one of the best of plans. These wires may be nearly straight (one end being free), or they may be bent to hook upon the teeth or to arch over them, and both ends be anchored into the plate.

Figs. 346, 347, 348 and 349 illustrate four modifications of such plates. The arrows indicate the direction in which the teeth tend to return, and the dotted lines the anchored portion of the fingers.

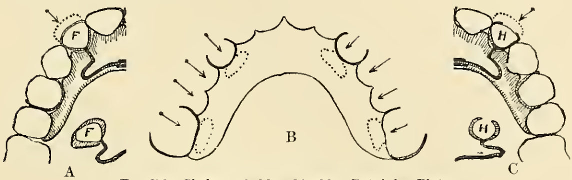


FIG. 350.—Skeleton Gold and Rubber Retaining Plates.

To retain teeth, after the enlargement of the arch, instead of the old-fashioned full roof-plates, slimmer shaped plates, with or without clasps, are excellent. See B, in Fig. 350. A, C, show two plans of adjustable-wire-on-plate devices.

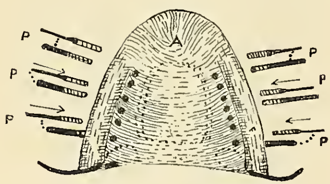


FIG. 351.—Adjustable Retaining Plate (A).

Fig. 351 is an illustration in parts showing the principle of an adjustable retaining plate. This plate can be altered to accommodate itself to different positions of teeth, while they are being moved forward to close a gap beween the centrals, by means of wedges forced between them.

The plan is to drill holes in the edge of the plate for the insertion of wires, which are screw-cut at one end and flattened at the other, (shown by the P's in the figure,) to serve as fingers to hold teeth in place. The figure of the plate shows several holes, in order to make the principle plain. In practice, however, only a sufficient number to suit the case are made. As these can be bored at any point, it will be seen that a finger can be set wherever desired. For an auxiliary to hold the plate in place to retain some of the teeth while others are being moved by it, the teeth being unfavorably shaped, a clamp-band should be vulcanized to each side of the plate to fit around any posterior teeth that are not undergoing the process of movement.

Devices of whatever design for retaining teeth by fingers projecting from them should be fitted so that the bearings upon the teeth will not cause an upward or downward force upon them, as this will tend to depress or raise the teeth in their sockets. Should this occur, however, all that is necessary generally, to reinstate the tooth, is to do away with such bearings.

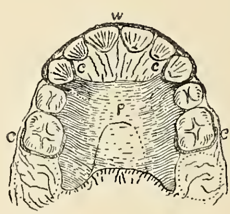


FIG. 352.—Retaining Device for Corrected Protruding Teeth (Modification of Kingsley's).

Retaining plates for corrected protruding teeth vary somewhat in construction, but the principles in all are few. They consist of plates with wires anchored to them, the wires being like fingers projecting between the teeth, as previously explained, or by extending all around. An easily made retaining device of the latter kind is shown in Fig. 352, the anterior portion of which resembles an old and familiar form, known as the Kingsley retainer. It consists of a hard-rubber plate fitted to the roof of the mouth and the lingual surfaces of all the teeth, to which is attached a wire, W, extending outward between the cuspid and first bicuspid of one side, around in front of the incisors, to the corresponding point on the opposite side of the plate, where it is again anchored (into the plate), as shown by dotted lines. This plate may be made full, as represented, or it may be of U-shape, as shown by the curved line P, or it may be still more skeleton. The device is held in place by clamps, C, C, C, C.

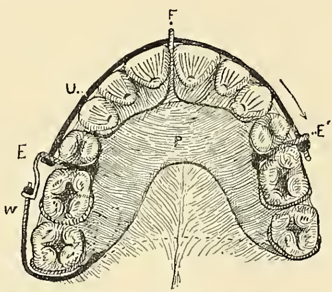


FIG. 353.—Adjustable Retaining Device with an Anterior Finger for Corrected Protruding Teeth (A).

Fig. 353 illustrates an adjustable all-round wire-retaining plate device for holding corrected protruding teeth in place. This also serves well to draw teeth back into line that have wandered astray from loss of a previously-worn retainer. This retaining device consists of a rubber plate, P, made U-shape (or full, as shown by dotted line), to which are fixed flat-gold fingers, E, E′, F, of stiff clasp gold plate, and four clasps. Through holes in the ends of the fingers, E, E′, F, passes a gold wire of about the size of a pin, one end of which is held in place by a head, E, and the other by a nut, E′, the latter serving also to shorten the arched wire, U, should the anterior teeth need to be drawn in. To prevent the springing of the side fingers, E, E, when necessary to make them thin, another wire, W, anchored into the posterior portion of the plate, is bent around independently of the clasp, and passed through a hole in the end of the bent side finger, E, and fixed there by means of a nut, as shown in the figure.

FIG. 354.—Side view of the Fingers in detail (A).

The metallic fingers of this device are shown in detail in Fig. 354. E, E show the form of the side fingers; F, F that of the anterior finger, and the figures below illustrate two other modifications of the anterior finger, showing it as attached at right angles to sheet gold for the purpose of firmly vulcanizing it into a hard rubber plate. Such plates may be sometimes held sufficiently firm by an air chamber, but it is safer to trust it to clasps, or other aids.

The oval hole in the finger, F, is to furnish the wire, U, an opportunity to play posteriorly when drawing it back, while tightening it upon the arch by the nut. This retainer is easily made and is very serviceable. Of course the shape and position of this finger, F, must be governed somewhat by the arrangement and occlusion of the lower teeth.

Fig. 355 illustrates a modification of the previously described device, differing in its having no middle finger to stay the arched wire, U. This wire is held by two short tubes soldered to the anterior surface of the side fingers, E, E, as shown in the figure. If the side teeth are separated

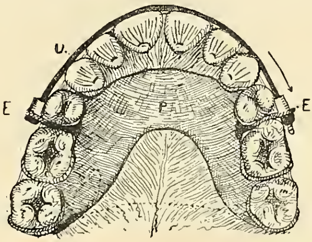


FIG. 355.—Retaining Device without an Anterior Finger, for Corrected Protruding Teeth (A).

sufficiently to enable these fingers to be made stiff, such tubes are adequate to prevent the front portion of the arched wire from falling.

Detachable gold Retainers.—A very delicate detachable retainer is made of half-round gold wire, the principle of which is substantially as shown by Fig. 356. This device,

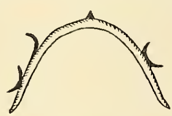


FIG. 356.—Half-round Wire Retainer (A).

although less inconvenient, is somewhat difficult to make. Even when made it is often exceedingly laborious to adjust it so that its bearings will be right in all parts, and being easily warped by its frequent removal for cleansing, such skeleton retainers can only be recommended to careful patients. Yet as they are very desirable, because convenient to wear, several forms will be described.

To properly make these retainers they should be swaged between metallic dies, in the same way as in the making of gold plates. When this device becomes accidentally bent out of shape so as not to fit the gums and teeth accurately, it may be bent by the aid of two flat-beaked forceps, but correct bending is often extremely difficult, the wire sometimes requiring to be bent in the opposite direction from that which would naturally seem right. Even with considerable care in making the device to press as desired upon the teeth of the cast, it will occasionally fail to do so in the mouth. When the distance between the retainer and a tooth is slight, the intervening space may be bridged by projections made by pinching at the proper point the edge of the half-round wire with a pair of powerful short-beaked forceps, but if the distance is greater, small pieces of plate should be soldered to reach out and bear as desired.

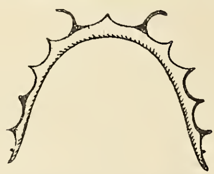


FIG. 357.—Gold Skeleton Retainer (A).

Fig. 357 illustrates one of my favorite forms of this class of retainers. This is made of two thicknesses of plate, swaged and soldered together and then rounded with a file to resemble half-round wire. When the teeth of the opposite sides of the arch incline from each other, I sometimes solder to each leg a pin point, as shown, to rest in very small pits in opposite molars. This figure was engraved from a device made for retaining teeth in a case of widening of the arch, and for holding in position the lateral incisors which had been turned. These pits were previously made to aid in retaining the posterior portion of the regulating apparatus in position.

Fig. 358 illustrates a similar device used in a case of widening of the upper arch, to hold in position the two centrals which stood apart, and to prevent the laterals, which had been turned, from turning back. The direction of the tendency of the teeth to move after having been corrected, and for which the device was made to resist, is indicated by arrows. Like the two preceding devices this is difficult to fit and somewhat easily bent out of shape by the patient after having been fitted, but so long as it fits prop-

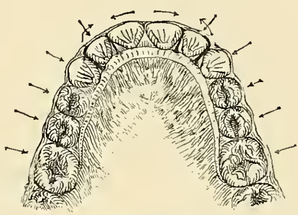


Fig. 358.—Retainer for Centrals and Laterals (A)

erly it is a very convenient device to wear. The white marks on the second bicuspids are short pieces of ordinary brass pins which were cemented into cavities to hold clamp-band portions of the regulating device upon the teeth, and which were temporarily allowed to remain after the operation.

Cantilever Crowns as Retainers.—When a tooth, such (for instance) as a bicuspid or a molar, is righted up, or the teeth are separated from each other so far that a wart filling is not practicable, a cantilever thimble-crown [1] placed upon one of the teeth (after it has been righted up), so that it will

[1] Published in "Dental Cosmos," March, 1884.

project against another tooth (that perhaps has also been righted up), see T, B, Fig. 359, will occasionally prove not only a very successful means of retaining teeth in place, but serve

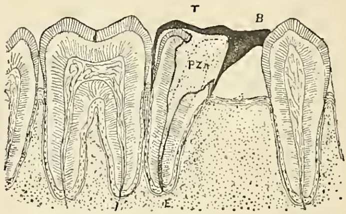


FIG. 359.—Cantilever Thimble-crown (A).

also as a substitute for the missing tooth. As the figure so plainly shows the construction of the cantilever crown, it will not be further described.

Splint Retainers.—Among the various kinds of retaining devices that are occasionally found valuable is the metallic hood or multiple cap, somewhat resembling the device made for an inter-maxillary splint in 1848, by Dr. Hullihen.[1] A multiple cap retainer was described by Desirabode, in 1823. A modification of it

FIG. 360.—Splint Retainer (Matteson).

by Dr. E. A. Matteson, was exhibited before the American Dental Association in 1885.[2] (See Fig. 360.) This was used for retaining in position the left upper central and lateral incisors, which were knocked out of the jaw of a boy twelve years of age. The retainer or splint was made of gold and platinum plate, swaged on a die, and then cemented to the teeth. Although such devices are not

[1] American Journal of Dental Science, Jan., 1849, Vol. IX., No. 2., p. 157.
[2] Transactions of the A. D. A., 1885, p. 85.

strictly relevant to the subject of regulation of the teeth, they are so applicable for this purpose that it is deemed advisable to explain them.

In the Transactions of the same Society, in 1887, Dr. W. C. Barrett describes a similar device, but made differently. (Fig. 361.) Instead of swaging, he simply burnished very thin platinum plate on the cast, and then strengthened it by flowing gold over the platinum. In order to clearly set forth these devices and their uses, the case in which Dr. Barrett applied it will be briefly explained: The patient was under seven years of age. One

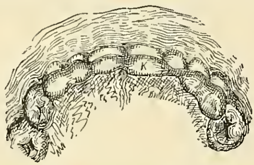


FIG. 361.--Splint-retaining Device (Barrett).

of his "permanent" centrals, which were just erupting through the gum, was knocked out. The child was brought for treatment forty-four hours after the accident. The tooth was undeveloped, being a mere shell, and the foramen widely open. It was first thoroughly cleansed, and the pulp chamber and root canal made aseptic. A piece of small platinum wire was then soldered at right angles to the plane of a very thin platinum plate sufficiently large to cover the end of the root. The wire was cut to a length that admitted its introduction into the tooth-canal through the foramenal opening. The root was then filled with oxyphosphate of zinc, and the platinum wire and plate placed in position, the latter being carefully "burnished" down over the end of the root, thus effectually and completely closing the open foramen. An impression in wax was then taken and a cast made, in which a hole was drilled at the point where the central was lost, into which a tooth nearly corresponding to the missing one was cemented with plaster, allowing it to protrude about as far as the lost tooth probably would at full development. A strip of very fine platinum, about No. 40, was carefully burnished upon the cast of all the teeth, including the inserted one. The platinum was then strengthened by flowing over the gold solder. The knocked-out tooth was inserted in place in the alveolus; all the teeth were wiped dry, and the stiffened platinum plate, filled with oxyphosphate of zinc, was carried to place and held until the cement had set, when the child could eat upon it. It was left in place three weeks, at the end of which time union seemed complete. Dr. Barrett did not encourage the parents to hope for the permanent retention of the tooth, but he did expect the child to retain it until the jaw was developed, thus avoiding a malformation. One year afterward, the other central had developed to the exact length of the replanted one, which was apparently quite as firm as its mate, and could not be distinguished from it.

The principle of the splint for retaining regulated teeth has not been taken advantage of as frequently as it might be. There are many cases in which one or two teeth could be retained much better by such a device than by the retainers that are commonly used. In some cases I use two or more gold thimble crowns soldered together, after which the partitions at their points of union are partly cut away.[1]

For retaining teeth in place that have been raised or depressed in the socket, there is no better device than some modification of the interdental splint.

[1] Desirabode's Splint (1823).

CHAPTER XXXVII.

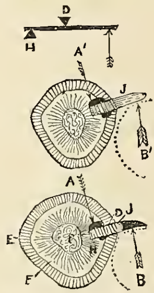
RETAINING PLUGS.

WIRE RETAINING PEGS.—WART-SHAPED RETAINING FILLINGS. —PHILOSOPHY OF TEETH EXCAVATIONS.

MENTION has occasionally been made of pins set in teeth and wart-plugs for holding corrected teeth in place. For some cases, if nicely made, these auxiliaries may be classed among the very best devices for retaining purposes. As their practicability depends so much on the manner of their construction they will be explained in detail. Beginning with the consideration of pins set in cavities we will then proceed to the consideration of the wart-plugs.

Wire retaining Pegs.—Pins to be fixed into cavities are of gold or platinum wire, one extremity of which is roughened or screw-cut and the other smooth. When there are natural cavities, pins are easily set with cement, but if the holes are to be drilled for the purpose it becomes a matter of nice calculation, for they should not be so large as to make it necessary to have a ring of cement around the pin to be exposed, nor should they be so small that the threads of the screw will crumble the enamel; yet they should be sufficiently large to permit the pin to enter snugly. Figs. 362 and 363 illustrate sectional views of lower cuspid teeth, showing the relation of the pin, J, to the enamel, E, dentine, F, and pulp, P. The figure at the top shows the philosophy of the leverage; D, fulcrum, H, resistance or weight, arrow the power or the point upon which the regulated tooth bears.

It is very important that the bearings of the screw or pin, when pressed against by the recently-moved tooth, B, as indicated by the arrows, should rest against the tooth tissue at the entrance at D, Fig. 363, and also at the bottom of the



FIGS. 362 and 363.—Screw Retaining-pegs (A).

cavity at H, and, although in contact, not to rest on the cement in which it is set. It is necessary in order to obtain firmness, however, to shape the pit so that there will be a little extra room in other places for a small quantity of cement, as indicated in black. When the dentine is thick enough, this chamber should be made entirely within it, as shown in Fig. 363, not sacrificing the enamel, as shown in Fig. 362. In this way the fulcrum, which is the enamel, D, will be strong and not crumble. After the corrected teeth have been retained in place long enough the pegs should be removed and the cavities filled with gold.

Wart retaining Plugs.—When teeth overlap, they may sometimes be retained in position after correction by simply inserting wart-plugs in natural cavities, if there are any in the approximal surfaces or in artificial cavities if the urgency of the case demands it, which is seldom. Fig.

364 illustrates the principle of wart-plugs, which, if rounded off and polished, are not objectionable. Indeed, I never saw, except under circumstances hereafter to be explained, more satisfactory results from any kind of retainer, because

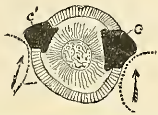


Fig. 364.—Wart Fillings for Retaining Purposes (A).

these may remain permanently without disfigurement or inconvenience. The durability of wart-plugs depends entirely upon the skill exercised in the operation. No "slipshod" method of inserting gold will be effectual. The plug should be made of adhesive gold inserted after the laminated method of filling teeth—that is, the foil should lie like the leaves of a book, one piece flat upon another, beginning at the posterior part of the cavity and extending outward.

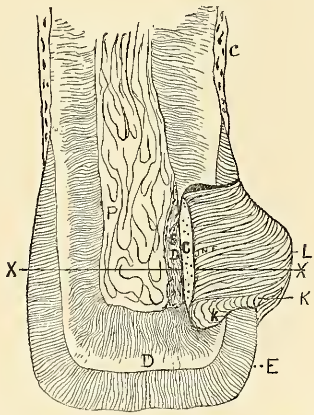


Fig. 365.—Longitudinal Section View of a Tooth and Wart-plug (A).

Fig. 365 illustrates a longitudinal section view of a central incisor having a natural cavity, showing this laminated construction of a gold wart-plug, as made by the author.

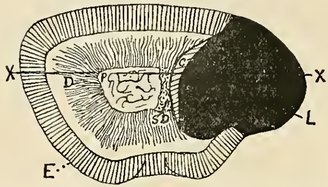


FIG. 366.—Transverse Section View of a Tooth with Wart-plug.

Fig. 366, a transverse sectional view of the same tooth cut in line of X, X, illustrates the same—L, the plug; E, enamel; D, dentine; P, pulp; S, D, calcified portion of pulp, ("secondary dentine"); C, capping material. The wavy lines shown in the plug, L, in Fig. 365, indicate the relation of the layers of gold with the tooth.

Beginning the operation in the usual way against the cervical wall of the cavity with soft foil, shown in black in Fig. 365, it is followed by piece after piece of laminated gold, cut either from a carefully prepared roll, or, better, from ribbon made of several thicknesses of cohesive sheets (perhaps heated). These are malleted together at all points, but more especially at the outer ends of the pieces, in order to bend them toward the gum, and give a solid surface. When the cavity is nearly filled, a key, K, of roll or rope foil, is forced into the undercut as shown by curved lines. This key renders the wart-plug very secure, and when all is properly finished and polished, it is not objectionable to the eye.

Fig. 367 illustrates the appearance of the anterior surface of a central incisor as prepared for the filling. This method of cutting a hatchway through the anterior portion of the tooth renders the operation of filling easier than to operate from underneath, and also leaves little or no disfigurement of the tooth. It is commonly thought that a filling should never show, if possible, but this opinion is not always sound, for gold thus inserted between the teeth often reflects a dark line to the eye, which, had the gold been made to ex-

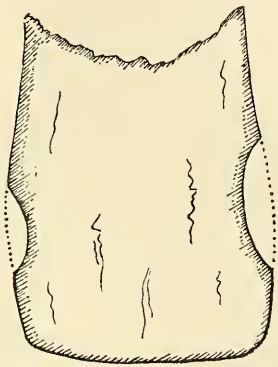


FIG. 367.—Central Incisor prepared for Filling (front view).

tend a short distance around on the anterior surface of the tooth, would form in the light a bright line which would catch the eye and render the dark line beyond unobserved. This is a form of plug that is not only more durable, but causes no disfigurement and is not very noticeable.

Fig. 368 illustrates a longitudinal section of a central incisor having two wart-plugs. The tooth is represented as divided after the plugs were inserted, so as to show the relation of the outer surface of the wart-plug with the inner portions and the inner parts of the tooth. In other words, the anterior half of the tooth is removed, leaving the plugs intact. The external surface of the plug, L′, L′, is shown in black, the internal, J, J, in lines. This figure also illustrates the form of the cavities.

Philosophy of Excavation minutely considered.—In the preparation of the cavity it probably is not necessary to mention to the majority of operators that to excavate in accordance with the "cleavage," or "grain," so to speak, of

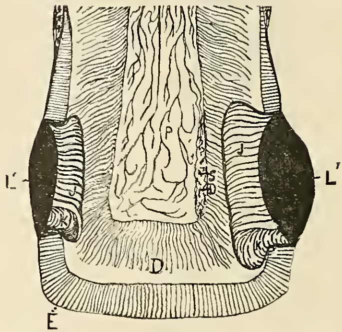


FIG. 368.—Wart-plug (section view of tooth only).

the enamel, is an important point, and one which should not be lost sight of. But as it may be instructive to students, an extract from a paper by the author, published in January, 1879,[1] is here given. As this point cannot be so clearly shown in a diagram of an incisor, it will be illustrated in a section view of a molar, drawn not only to show the philosophy of proper excavation of a cavity, but the details of management of the worst conditions, including an exposed pulp (Fig. 369).

In this figure the position of the enamel rods are illustrated by lines radiating from the dentine, and the heavier lines on the margin of the cavity show how the enamel may be cut without weakening and rendering it liable to "chip out" around the filling. It also shows by other lines where the rods may and also where they should not be

[1] "Missouri Dental Journal," January, 1879.

diagonally cut, in order to prevent chipping. This would occur if they were cut along the dotted line on the right, but would not if cut as shown on the left.

In preparing the dentinal portion of the cavity when the pulp is exposed, it is well also to cut away the walls and floor, so that not only the filling, as a whole, may be firmly anchored, but that the ends of all dentinal tubes, leading

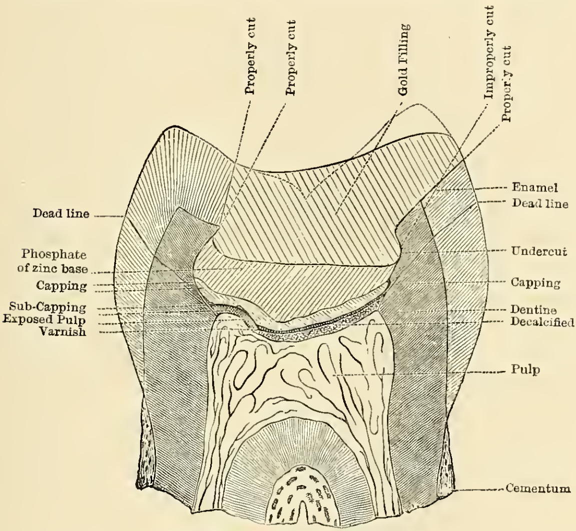


FIG. 369.--Philosophy of Excavating a Tooth.

directly from the cavity to the pulp, may be covered with varnish (the best kind of which is fir balsam dissolved in chloroform).[1] But to accomplish this double object, all cavities in the grinding surfaces of teeth, where great pres-

[1] The genuine fir balsam is not often found in market; the imitation is pine pitch, which will not harden, therefore is not fit for capping purposes. I get fir balsam direct from the forest by gathering the "tears" that ooze from cuts in the trees. The water in the tears should be evaporated.

sure is to be made, should, if possible, be so shaped that when the zinc cement base is inserted and has hardened, it may rest firmly, not to bear hard upon the thin dentinal flooring over the pulp, nor upon the capping varnish, if any is used, but upon the centrifugally inclined floor of the walls of the dentinal structure around about. In approximal cavities, however, where there is not much pressure applied, this precaution is not necessary.

In case of exposed pulp, having applied wood creosote and deposited the proper quantity of varnish—which should be very limited—upon the exposed point, it must be carefully made to spread over the floor of the cavity with a delicate instrument until all the dentinal tubes leading from the cavity directly to the pulp are covered, in order, as before implied, to cut off all irritation that may cause pain. This may be easily understood by reference to the figure, where the dead-lines show the division between the dead and the living portions of the dentine and enamel.

While the application of varnish is important in order to prevent pain, it should not extend much beyond the "dead line," nor smear any more of the walls than is necessary; for in that case it may injure the firmness of the main filling.

Having deposited the varnish, it is not necessary to wait for all of the chloroform to evaporate before applying the thin covering of phosphate of zinc, which should be of the consistency of cream, so plastic that if applied delicately, it can be spread over the entire surface of the varnish without displacing it. The smooth coating of varnish is soothing to the pulp and insulates it, as it were, from the cement. Should, however, the varnish coating be injured, pain will generally follow in proportion to the extent of the injury of the insulator. This varnish prevents disintegration of the cement, which is sure to follow in time if the juices of the pulp are directly exposed to it.

Having the pulp protected, and the varnish hermetically sealed in by the cement, the chloroform is retained and made useful by acting upon the exposed portion of the pulp beneath; and the morphine mixed with the wood creosote acting upon that portion of the crown of the pulp which is not exposed, the entire pulp is soon rendered sufficiently insensible to any slight irritation that may take place—a condition tending to obviate any "shock," and which will continue until nature has time to act and becomes habituated to the new environments—a point of great value to both patient and operator.

Having accomplished the important point of painlessly protecting the pulp, a proper additional amount of cement, harder than that used for the flooring, should be introduced, after which, when it is sufficiently hardened, it may be dressed and shaped in readiness to serve as a basis or foundation upon which to build a wart-plug. This operation, though applicable to approximal cavities in the front teeth when it is possible to carry it out, is especially valuable to molars requiring wart-plugs for keeping the jaws apart while "jumping" a tooth, or in operations for correcting protruding teeth where the lower incisors are so long that they bear upon the upper teeth.

PART VIII.

Laboratory Rules for Making Regulating Devices.

CHAPTER XXXVIII.

DETAILS OF REGULATING APPARATUS.—GENERAL REMARKS.

MATERIALS.—PARTS OF DEVICES.—CONSTRUCTION.

FOR the interest of the younger members of the profession, a few suggestions are offered as to details in the construction of regulating apparatus on the various plans mentioned in this work; also, a brief mention of the kinds of tools and materials necessary to use. I shall, however, regard the reader as being sufficiently "up" in the minutiæ of laboratory work; such as soldering, etc., to render it unnecessary to enter fully into the particulars of everything described. Before entering on details, a few preliminary remarks bearing on the subject will be made. In a text-book for the use of students, which is largely the intention of this work, a certain apparent if not actual repetition is unavoidable. The general idea kept in view by the author has been to give descriptions and illustrations of the devices used, in Parts VI., and VII.; the method of constructing them, in Part VIII.; their practical application to cases, in Part XV., and the esthetic aspect of the art in Part XXI.; the two latter topics being of too wide a range and occupying too much space to be included in the first volume. It is, of course, impossible to prevent these divisions of the subject from occasionally impinging on each other; nor has any great effort been made to avoid this result, the author believing, as he has stated in his Preface, that where reference to past or future matter is needed to render an explanation more intelligible, it is more judicious to repeat in substance some passages than to occupy the time of the reader in searching other portions of the work. The description of devices and the method of making them are subjects so closely connected that they might almost be regarded as one, yet there are some to whom the methods of manufacture would be of little interest, while others would be pleased to have precisely those details uncomplicated with other matter. The course adopted is chosen as the one best fitted to the needs of the majority of readers.

In the following pages the rules for construction will be brief, but sufficiently full, it is believed, to be useful to those who study them. No attempt will be made to use abstruse or technical phraseology. The effort in this as in all other Parts will rather be to simplify explanations as far as possible by the use of simple language.

Materials.—Following is a list of materials and devices such as are usually found in well-appointed laboratories. Apparatus for causing continued force are made of two classes of material, elastic and non-elastic. Among the elastic materials now in use are strips of gold plate, hard rubber, soft rubber cut from belting or from tubing, and linen or silk thread. The materials used as basal support for these, when support is necessary, are gold, silver, platinum, and hard rubber. Besides these, various sizes of piano wire, spring gold wire and small thread-like wire of gold and platinum are used.

Apparatus for causing intermittent force is made of metal, such as gold, silver, platinum, and iridium; also of hard rubber, wood, and linen or silk thread, shaped and arranged in such a manner as to be practically inelastic. The metallic materials consist of half-round wire or plate, sometimes made in the same manner as that used to support artificial teeth, but in most cases rolled wire is preferable for this purpose. As between platinum and gold, I prefer for general use the latter, which, in order that it may retain its proper color, should not be less than 18 k. This preference arises from the fact that gold fills the greatest number of offices as means to ends; and besides this, patients prefer it. As between 18 k. gold and a mixture of gold and iridium, gold and platinum, or platinum and iridium, opinions differ. They are all excellent, but those metals that are not too hard, such as 18 k. gold, are sometimes more practicable, because they can be bent to suit change of conditions. Again gold screws and nuts when somewhat worn, if the threads are not entirely gone, can still be used for some time, often sufficiently long to allow of the operation being completed, by simply compressing the nut upon the screw with a pair of forceps. Except for plates, or parts of plates, which require plate material, some of the parts, such as nuts, are made of large square or round wire, or globules made of scraps melted in a pit in a piece of charcoal or in a crucible.

Parts of Devices.—Parts and wholes of intermittently acting apparatus, such as may be kept on hand in several sizes for ready use, are as follows: — Plain screws, fish-tail screws, triplex screws, non-irritating thimbles, jacks, nuts, balls, tail-jacks, pushing-jacks, dragging-jacks, improvisable-jacks, spindle-jacks, non-irritating jacks, yoke-jacks, swivel-jacks, wire crutch-jacks, ferules, gum-guard rings, draw-bands, clamp-bands, turners, keys, metallic separators. long-bands, T-pieces, cones, staples, and small rings to solder to apparatus, cheek-wires, ear-rings for skull harnesses, ear-ring swivel, to use on cheek-wires, piano-felting for cushions, and silk braid for external gear.

For ribbons, bars, and nuts, wire should be used; they vary from one-sixteenth to one-eighth of an inch in width.

Bands and similar parts should also be made of wire rolled or hammered flat to the proper thickness, and afterward cut to the desired width and length. As stated in other chapters, plate is so weak as to be worthless for this class of devices.

Construction.—The *four essential points* to be attained in the construction of devices for the correction of irregularities, are *practicability*, *simplicity*, *convenience*, and *cleanliness*. It is also important to achieve perfect accuracy of fit, especially at the points where pressure is most needed, and at the same time to leave sufficient margin for adjusting alterations. Even after the fixture has been made as accurately as possible on a cast, it frequently requires more or less alteration before it can be secured on the natural teeth. It is hardly necessary to urge the importance of having all the sharp points of the fixtures filed and rounded off, in order that they may not irritate the cheeks, lips, or tongue. The adaptation of the apparatus to the teeth consists chiefly in making the bands, etc., which extend around them, of such size and shape that they will hug firmly, and with such relation to the surface plane that they will not slip off.

A variation in little things is sometimes of great importance; for instance, if a screw irritates the cheeks it should be cut away, or a little melted shellac placed on the end; but a small globular-shaped thimble of metal or hard rubber or even gutta-percha will often prevent irritation, possibly making a success of that which might otherwise have been a failure. These auxiliaries, however, are seldom necessary if the devices are nicely made.

As has been said, all fixtures should be made as light and delicate as is consistent with strength. The general tendency with beginners is to make apparatus too clumsy. Very much depends on delicacy of parts and accuracy of fit. In other words, the different parts should be strong enough to accomplish the work, and not be more cumbersome than is necessary for efficiency. Of course it is important, in order to render apparatus effective, that the dentist should thoroughly understand the philosophy of the application of force of mechanical devices upon the teeth. This is explained in Part IX.

An idea has been advanced that the use of metallic apparatus is injurious to the teeth, but while it is true that hard steel, if very sharply serrated, may scratch the surface of soft teeth, gold and platinum are free from such objections and are as little injurious as hard rubber. In fact, it is impossible to scratch tooth tissue with these metals. I have never yet seen in my practice a case in which injury has thus been caused by any apparatus made of gold or platinum. I do not regard it as necessary to dwell further upon these points, than to reiterate that fixtures of any kind should be kept clean, the *débris* not being allowed to remain too long between them and the teeth. For the purpose of cleansing the devices a syringe is necessary.

The first application of the fixtures occasionally requires considerable time and patience, but this once accomplished, if the apparatus is properly constructed, the main part of the difficulty of regulating is surmounted. In most cases I use intermittently acting fixtures, and having applied the apparatus, if the patient is sufficiently intelligent, I give him a key, and he assists me by carrying on the movement at home. This is what I sometimes call regulation of teeth made easy, because by it I am relieved of much of the labor. Some practitioners do not advocate this, but I find it a good plan. If the devices used are loose or rickety, however, it is advisable that the dentist should see the case often—indeed he must see it often, as otherwise the operation will generally prove to be a failure.

CHAPTER XXXIX.

DETAILS CONCERNING THE MANUFACTURE OF SCREWS, NUTS, ETC.

INDEPENDENT OR MOVABLE NUTS.—STATIONARY NUTS.—SCREWS AND BOLTS.—BOLT HEADS.—SCREW WIRE.—RIBBONS FOR BANDS.—FLAT CLAMP-BANDS.—FLARING THE BAND.—ROUND PLATINUM WIRE CLAMP-BANDS.—SHORT-BANDS AND LONG-BANDS. — LOCKING OF LONG-BAND SCREWS. — T-PIECES. — EAR-LUGS. — ANCHOR-FERULES.—WIRE TONGS AND NESTS.—CLAMP-BAND AND FERULE APPENDAGES.—GUM-GUARD RINGS.—CONNECTING BANDS.

A COMBINATION of platinum and iridium is probably the material for the best nuts, but for general use I prefer 18 k. gold, because it is more easily manipulated. Independent nuts are generally made from square wire cut into blocks of appropriate lengths, but scraps of gold melted into globules on a piece of charcoal or in a crucible, and afterward shaped by a hammer and filed to the required size, though the process is slower, make nuts that are fully equal to those made from square wire. Having made these blocks nearly of the proper shape, they are drilled and threaded by a tap corresponding in size with the screws to be used in them, after which the nuts are finished to suit the circumstances of the case. The square form, rounded at the top, to prevent irritation of the tissues, is not only practicable in this respect but readily fits large keys for watches. It is not necessary, however, to adhere rigidly to this shape. The finishing may be given to nuts by a file, but this can be done more rapidly by the use of a pair of powerful die forceps, or by a strong press-screw and a die made for the purpose. In ordinary practice, however, these are not needed.

When I use movable nuts, which is not as often as in former practice, those of about one-sixteenth of an inch cube or a little more, if there is any danger of destruction of the threads, seem to me preferable ; but when so much power is desired that a cube would be too clumsy, an increase in the number of threads by greater depth of the nut only, will accomplish the same object as a larger cube. There is also another point to be remembered: a larger number of finely cut small threads in a nut afford as much force as a less number of coarser threads, but taking into consideration the element of salivary calculi which sometimes collect upon the threads of screws and nuts, the coarse thread may be deemed more practicable than the fine.

Stationary Nuts.—Nuts to be soldered to other parts of devices, as, for illustration, to clamp-bands, should be made in the shape that will best serve the purpose, combined with the least inconvenience to the patient. For this purpose, the cube or block-shape nut, cut from square gold wire or from spherules made from melting gold scraps, as before mentioned, can be used. But a much more convenient method of making a light nut is by using what is called jewellers' "piping" or "hollow wire" (tubing) cut into suitable lengths. Another way is to take thick 18 k. gold plate, and curve it into tubular form, and then draw it through a series of holes in a steel draw-plate (such as is made for drawing wire) until the edges of the gold plate are firmly forced together, when the seam should be well soldered with 16 k. gold, and then drawn again through the steel plate, in order to make a uniform surface, after which the tube is cut into ferules of suitable length for the nuts, and then reamed out to nearly the size of the screw that is to be used, care being taken to make proper allowance in the size necessary for the screw threads. In soldering the nuts to other parts, the seam should always be placed against the device to which it is to be soldered, when the solder will hide the seams at the same time.

Screws and Bolts.—These vary in size and length to suit different devices and parts of devices of which they constitute a portion. Some need to be stronger than others. Their threads should either be coarse, if few, or fine, if in greater number. Screws to use between teeth are not required to be very strong, consequently the threads may be very fine, from 100 to 125 or even as high as 144 to the inch. As screws very often become useless in consequence of the threads being injured, it is well to confine their manufacture to a few sizes, say three or four. This frequently affords an opportunity for repairing damages easily, or making a substitute for disabled regulating apparatus by resorting to the stock on hand. The heads of screws and bolts may vary in form, but are usually limited to two shapes—the globular, which is perforated with a hole fitting a lever key, and the angular, which fits a watch-key.

There are two methods of making screws, the most rapid being by the use of a lathe, which, by fixing one end of the wire, the screw plate or the die being held steadily by the hand, the wire becomes threaded in feeding through it. The collar or shoulder between the screw and the key-nib can also be turned in the lathe, and the nib squared afterward by a file. This method requires a jeweller's lathe, a somewhat expensive machine; but screws made by tools such as files, a screw-plate or hand-die, with a set of taps, (though slower), are equally effective; and as this is the usual plan, our suggestions will be made mainly with reference to it.

To prepare the wire for threading, it may be held on the bench-pin by a hand-vise and rolled under a file, or it may be run through a chuck (made for the purpose) in a lathe.

FIG. 370.—Hand-vise.

Fig. 370 illustrates a jeweller's hand-vise, which is generally preferred in manufacturing screws and nuts, because it has no thumb side-screw. There are several sizes in the market.

To cut a screw thread on a wire requires some care to avoid twisting the wire and so weakening it. To prevent this, the wire should be held in grooved forceps or in a vise-splint, allowing at first only about one-fourth of an inch of wire to project from it, which is then threaded, after which the wire is made to project about as far again, and then the threading die is run over it, and so on until the wire has been projected to the desired length of the screw, and it is all threaded; it is then cut off and headed.

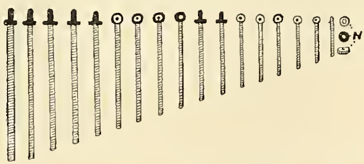


FIG. 371.—Different Sizes of Screws, showing two forms of Heads.

Bolt-heads.—Screws and their heads may be made in one piece, the original size of the wire squared with a file, and the screw portion made smaller by filing or by hammering, or the head may be made by the addition of solder to the end of the screw, the collar, N, being first fixed on the screw. (Fig. 371.)

A very easy way of making a bolt is by the Waldieran plan, which is first to screw-cut the wire, and having placed about one-fourth of an inch of "hollow wire" or piping, of a size to fit snugly on one extremity, it is then soldered to the screw, but leaving enough to constitute a collar flange. The remainder is filed square to fit a key.

FIG. 372.—Showing how to form a Bolt-head.

Fig. 372 illustrates the different stages of the process of making the head, and also shows that the head may be made on either end of the screw. That shown on the left side of the figure is the more economical, because it utilizes the vise end of the wire. Spherical heads may also be made by the same process, by using shorter pieces of tubing, which, after being soldered to the screw, are filed to the shape desired.

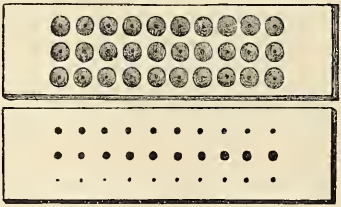


FIG. 373.—Steel Draw-plate, back and front View.

Screw-wire.—Wire for making screws should be strong and perfect in texture; therefore, in selecting this material, it should be examiued under a magnifying glass. It should also be of uniform size throughout. In order to secure this it may be drawn through a steel draw-plate, such as is shown in Fig. 373.

Having filed one end of a piece of wire so that it is slightly tapering in shape and small enough to enter a hole in the draw-plate, somewhat smaller than the body of the wire, it is drawn through with powerful pincers. Afterward the same process is repeated in a series of smaller holes until the wire is reduced to the desired size. If only three sizes of screws are adopted, the wire is drawn down to about 15½, 18½, and 20½, gold plate gauge, after which it is cut to any suitable length, say from three-fourths of an inch to one and one-half, but it should always be cut not less than one-fourth of an inch longer than the screw is intended to be, in order to have a stub for holding it in a vise while being threaded.

TABLE No. 1.

DIMENSIONS BY THE GOLD PLATE GAUGE, AMERICAN STANDARD.

Sizes of Screw Wire.	Number of Threads to the Inch.	Size of Loose Nuts to Correspond.	Length of Fixed Nuts.
About No. 20½	About 144	$\frac{2}{32}$ to $\frac{3}{32}$ an inch cube.	$\frac{2}{32}$ to $\frac{3}{32}$ of an inch.
" " 19½	" 125	" " " " " "	" " " " "
" " 18½	" 100	" " " " " "	" " " " "
" " 17½	" 88	" " " " " "	$\frac{1}{8}$ " $\frac{2}{8}$ " "
" " 16½	" 80	" " " " " "	$\frac{2}{8}$ " $\frac{3}{8}$ " "
" " 15½	" 72	" " " " " "	$\frac{3}{8}$ " $\frac{4}{8}$ " "

While the dimensions given in this table for gold screws are suitable to any work, they need not be followed too strictly; but having adopted a set of sizes, it is judicious to adhere to it, in order to have duplicate parts ready for use in case of emergency. Especially is this true of screws, which often require to be exchanged for longer or shorter ones during the process of nearly every large operation.

FIG. 374.—T's.

T-screws to rest between the teeth should be very small, having about 125 to 144 threads to the inch. To show differentially how small this thread is, ordinary steel screw-jacks, obtainable in the shops, have about 48 threads to the inch, and gold screw-jacks, as I generally make them, have from 60 to 100 threads to the inch. The number of threads per inch depends not upon the size of the wire so much as upon the dies; therefore, this should only be taken as an approximation. The principal value of table No. 1 is to show the proper sizes of wire for screws.

Fig. 375.—Sizes of Keys for T-nuts.

Ribbons for Bands.—Ribbons for bands and splice-straps for embracing the teeth should be thin and pliable, especially the portions which are to rest around the teeth that require to be tightened by bolts. It should also be remembered that strength is attained by breadth as well as by thickness of ribbon material. Disregard of this point may lead to failure.

For lateral incisor teeth, the bands should be very narrow and as thin as writing-paper, but for side teeth they must be thicker and stronger. For the comparative thickness of the various bands see Table No. 2.

TABLE No. 2.

Ribbons.	Thickness.	Breadth.
For molar teeth.............	No. 31–32	About $\frac{2}{32}$ to $\frac{4}{32}$ of an inch.
For bicuspids.................	" 31–35	" $\frac{1}{32}$ " $\frac{2}{32}$ " "
For cuspids and upper central incisors..............	" 35–36	" $\frac{2}{32}$ " $\frac{3}{32}$ " "
For upper lateral and lower incisors..................	" 35–36	" $\frac{1}{32}$ " $\frac{2}{32}$ " "
For retainers.................	" 35 or less.	" $\frac{1}{24}$ or less " ".

As will be seen from this table, the thickness of ribbon bands for extending around molar teeth should generally be about No. 31 to 32. For cuspids and for front teeth they should be thinner, from 35 to 36; and from one sixteenth to three thirty-seconds of an inch wide.

Bars.—If a long-band is a portion of a clamp-band (Fig. 266), it is cut from rolled wire or plate. Short bars, as illustrated in Fig. 379, and lingual bars, as in Fig. 416, are, also, of the same material.

TABLE No. 3.

APPROXIMATE DIMENSIONS OF ANCHOR-BAND BARS.

Buccal Bars.	Thickness.	Width.
For molar teeth................	No. 22–28	About $\frac{3}{32}$ to $\frac{4}{32}$ of an inch.
For bicuspids...........	" 34–35	" $\frac{2}{32}$ " $\frac{3}{32}$ " "
Lingual bars for molar and bicuspid teeth............	" 20–21	" $\frac{1}{16}$ " "

Table No. 3 shows the approximate dimensions of these stiff strips of gold, either for the buccal or for the lingual sides of these anchor-bands. Of course, the dentist must be governed by the conditions of his case, and deviate from these tables when necessary.

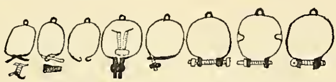


FIG. 376.—Stapled Anchor-bands for Single Teeth.

Anchor-bands for single teeth.—Most anchor-bands now used are of the longitudinal screw clamp-band form, but other forms are occasionally useful. Of the latter, five modifications are shown on the left of Fig. 376. At the right are shown three modifications of the former.

The first of the set of five illustrations is of a wire twisted upon itself; the second is a wire with a loop at each end, which is tightened by a wedge; the third is a wire hoop, united by hooks on the extremities, which is not often practicable; the fourth is united by a nut screwed on a split screw; the fifth is tightened by a screw on one extremity of the wire, passing through a loop on the other. The sixth is tightened by a bolt with an independent nut, the bolt passing through right-angled smooth-bored nuts soldered at right angles to the extremities of the band. The seventh and eighth are made of rolled wire, and are tightened by screws passing through nuts soldered to the bands.

Fig. 377.—Anchor Clamp-band (A).[1]

Fig. 378.—Band for Retainer (A).[2]

Figs. 377 and 378 illustrate two modifications of single tooth anchor-bands, which are sometimes serviceable as temporary retainers. The former also becomes useful as a lever.

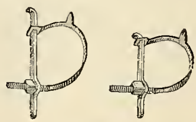


Fig. 379.

Fig. 380.

Figs. 379, 380.—Different sizes of another Modification of Single Transverse Screw Clamp-bands for Anchorage Purposes (A).[3]

Figs. 379 and 380 show different sizes of one form of the transverse screw clamp-band, which is used for anchoring other devices, such as screw-jacks and long-bands. The duplicate transverse screw anchor-bands, or the anchor-bands having two screws forming a U-shaped bow with the screws entering oval holes in a bar, as shown by Fig. 267 in Part VI.,[4] are similarly made. As before said in this work, there is an objection to these transverse screws, the one which led me to abandon their use as a rule. This

[1] "Dental Cosmos," January, 1878. [2] "Dental Cosmos," October, 1877.

[3] In some text books these anchor-bands have been erroneously described as "rotators." They *are* sometimes used as retainers.

[4] Published in "Dental Cosmos, June, 1878, page 308.

is the pain and difficulty which accompany their insertion between the teeth, even when the necks are sufficiently separated, and in many cases it is impossible to insert them at all, for want of room. Of the various anchor-devices for securing apparatus, I have found none so simple and effective as some of the various forms of clamp-bands having a horizontal screw with a triple nut, to which other devices may be attached.

If a ribbon is to have a screw on one end, it should be made by hammering one extremity of the same piece of wire of which the screw is made. The rectangular loop for embracing the thick bar, Fig. 379, is made of small round wire or narrow flat wire soldered to one end of the ribbon, as shown.

The connection of jacks or other devices used is also made by rings, staples and hooks soldered to the anchor-bands, as shown in Fig. 380.

Fig. 381.

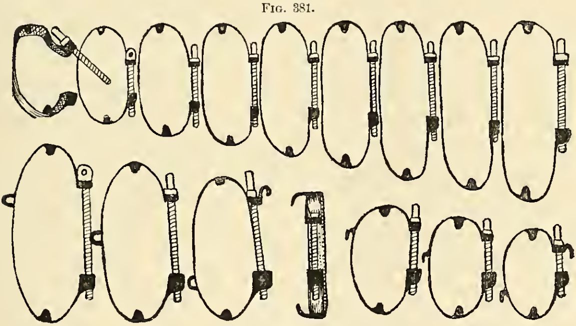


Fig. 382.

Fig. 381.—Flat Clamp-bands (A).[1] Fig. 382.—Anchor Clamp-bands (A).[2]

Group Clamp-bands.—Fig. 381 represents a set of various sizes of longitudinal screw group-bands, such as are useful

[1] Published in "Dental Cosmos," January, 1876–78. [2] Febr'y–June, 1878.

for moving teeth along the line of the alveolar ridge, as, for instance, drawing a cuspid into the place of an extracted first bicuspid, and Fig. 382 shows the form of various sizes and modifications of anchor-bands made on the same principle. As will be seen, the only difference between these, and those shown in the previous figure, lies in the addition of anchor hooks and staples for the attachment of other devices.

The details of manufacture of both of these varieties of clamp-bands have been so often implied, if not explained, that little further instruction seems necessary. The wire (18 k.) is first hammered to the desired thickness on a steel anvil, or made flat by being passed between steel rollers (see Table No. 2), after which it is cut with shears into ribbons of proper width and length, and then the nuts for the screws are bound in their proper places upon the strips with steel hair-wire, and united with 14 k. solder over an ordinary laboratory alcohol-lamp. A blow-pipe is sometimes necessary, but if used caution should be exercised to avoid melting the thin parts. Staples, hooks, and ear-pieces are bound and soldered to the bands in the same way; sometimes, however, it is necessary to fix each part on a piece of charcoal by pieces of bent steel wire driven into the coal.

Flaring the Band.—In regard to the shape of the (band) parts of the fixtures which serve as anchor-bands, they should be so made that they will pinch at points on the teeth between the prominences on the crowns, and the gums.

For illustration, suppose it is desired to use the clamp-band for the purpose of drawing a cuspid posteriorly by using the first molars and the two bicuspids for anchorage, as in Fig. 383:

Instead of having the band made broad and square like a ring cut from a straight tube, as at *a*, Fig. 384, it should flare as shown in excess at *b* (same figure), so that the gum margin of the band, as before said, will rest below the prominence of the crown. This flaring is made by hammering the opposite margin; sometimes the same result may be attained by simply bending the gum-margin of the band inward toward the neck of the tooth, or by placing a little solder to it so that it will bite strongly upon the (neck of the) tooth. If the neck is larger than the crown the band can be made to hug closely in a slight hollow ground in the tooth for the purpose, but grinding should not be resorted to until other means fail, and then it should never be carried so far as to injure the tooth. If there is a

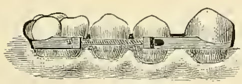


FIG. 383.

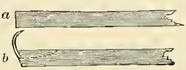


FIG. 384.

FIGS. 383, 384.—Showing formation of Clamp-band when it is necessary and yet difficult for a broad square Band to pinch at Points near the Gum.

cavity in the approximal surface of the tooth, advantage may be taken of it to insert a wart (amalgam) plug, packing the entire space between the tooth and band; or if the cavity is in the antagonizing surface, a piece of bent pin with its head set in cement, so that the other end will project at right angles over the clamp-band, is sometimes effective. A cross platinum wire extending between the teeth binding the two sides of the clamp-band when practicable is better.

Improving the Bite by narrowing the Band.—Though other parts of the band may be wider, the portion which bears upon the posterior portion of the tooth will sometimes be made to hold firmly if it is narrower, say $\frac{3}{32}$ of an inch; but generally speaking, better $\frac{2}{32}$ of an inch. On account of the thinness of these clamp-bands the narrow portion should not extend much beyond the bearings, as the band would be apt to twist when turning the screw. It is generally advisable to have the remaining portion of such bands about one-eighth of an inch wide, or a little less, in order that it may rest flat against the side of the tooth or teeth, sufficiently to aid in preventing this twisting. Should it have a tendency to do so, however, it may be prevented by firmly grasping the nut (soldered to it) with long-beaked forceps during the time that the screw is being turned. The beaks of such forceps should be slender, and not less than two or three inches in length. (See Fig. 383.)

Platinum-wire Clamp-bands.—Sometimes, instead of narrowing the band, this portion may be made of platinum wire about the size of a pin. The conditions requiring the narrowing of the bearings are not so often found as those requiring this wire. In fact when teeth are so short that the bands will not hold sufficiently firm upon them, they may be made entirely of platinum wire (about the size of a pin), the nuts being soldered to the ends in the same way as to ribbons. Such clamping devices are often very practicable, especially for partially erupted cuspids. These wire bands are more easily made than the ribbon bands, and, if there is room enough between the teeth, they are also more readily applied, because they can be easily bent so as to lie low in the gum on the neck of the tooth, and if necessary beneath the gum; the platinum wire being very flexible, and not very elastic, it will not spring out of place. If clamp-bands, whether of flat gold or platinum wire, are made smooth and free from irritating surfaces, the gums will tolerate them much better than they will strings which furnish a habitation for bacteria. Sometimes the shapes of the teeth that are bound together in a clamp-band are such that one of them may tend to rise or sink in the socket. The tendency to rise by such wedging is generally confined to the middle tooth. This is generally prevented from doing harm by lugs or ears on the middle portion of the band, so as to extend over the antagonizing surface and bear upon the tooth. This will not only arrest the rising of a tooth, but will prevent the end of the clamp-band, and consequently the tooth, from sinking.

FIG. 385.—Short-band (A).

Long-bands and Short-bands.—Bands for extending from the bicuspids or molars of one side of the mouth around upon the front teeth, or entirely around so as to be attached to corresponding teeth of the opposite side, may vary in width and thickness, but they should not be so slender as to bend too easily, or there will not be sufficient strength to the arch, nor should they be so stiff as to cause difficulty in adapting them to the teeth. Still, when it becomes necessary to make a long-band act on any special tooth or teeth by bending it correspondingly, the band should be firm. It should be of plate, half-round or flat wire, the latter being generally preferable. Having cut the strip of proper length, a small smooth-bore nut or a short piece of tubing is soldered at right angles to each end. These nuts are intended for passing screws to fasten the long-bands to the anchor-bands, as shown detached in Fig. 386. It should be

FIG. 386.—Extremity of the Long-band and its Screw, showing their Relation to the Anchor Clamp-band (A).

mentioned, however, that if a sliding T-piece is to be used this should be made and slided on the long-band before the nuts (or ferules for cheek wires, if used) are soldered to it. When completed, this long-band, like all such devices, should be polished; indeed, gold regulating fixtures should look like fine jewelry. This is done by felt wheels in a lathe or by hand brushes, after having used fine files and emery paper. To give the final lustre, they should be burnished with a highly polished steel instrument.

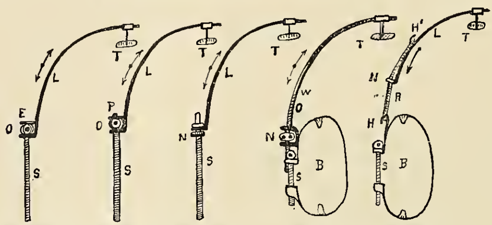


FIG. 387. FIG. 388. FIG. 389. FIG. 390. FIG. 391.

FIG. 387--390.—Lock-screws (A). FIG. 391.—Long-band attached by rubber (A).

Locking of long-band-screws.—There are several ways of locking screws to long-bands. The above half figures illustrate four that have proved useful to me.

Fig. 387 illustrates a simple plan, which consists in soldering a second lug, E, to the long-band, L, just anterior to the spherical head, O, of the screw, S.[1]

Fig. 388 is a slight modification of the latter, differing only in the head, O, of the screw, S, having a delicate extension, P, projecting through a hole in the second lug, the object of which is to steady the screw S.

Fig. 389 is a plan that I prefer to either of the preceding. This consists in placing a nut, N, on the screw, S, on the opposite side of the long-band nut. This nut, N, may be screw-cut and fixed in place by compressing it tightly upon the screw by means of forceps or it may be soldered to it.[1]

Fig. 390 shows quite a different plan. In this device the

[1] Explained in a lecture in 1885; published in "Cosmos," March, 1886.

screw, O, and the long-band, W, are one. Unlike the others, the long-band is a round wire threaded at each extremity; upon each of these ends is a nut, N, which plays between two ears soldered on the long-band. These ears may be separately made before being soldered, but better if made of one piece of stiff plate bent in a U-shape, as shown.

Fig. 391 represents another plan of connecting a long-band with a clamp-band. This is by means of elastic rubber rings caught on hooks, H, H.′ This is not a locking device, nor is it reversible; it can only operate the long-band, L, in one direction. In detail this device consists of an anchor-band, B, having a hook, H, and a long-band, L, with a sliding T-piece, T, hook, H′; it also has a staple, N, on each end, through which the rubber rings pass when stretched from hooks, H, to hooks H′. The object of the staples, N, is to steady the long-band. When elastic rubber rings are to be used in connection with long-bands, for drawing upon in-standing teeth, they may be caught upon small hooks of gold wire soldered at suitable points on the band, as shown in Fig. 293, p. 336.

FIG. 392.—Stationary T's (A).[1]

FIG. 393.—Sliding T's (A).[2]

T-pieces.—T-pieces are of two varieties, the stationary and the movable or sliding. They are used for preventing long-bands from sliding upon the teeth and impinging upon the gum. The stationary T is soldered directly upon the long-band as shown in Fig. 392. The drawback to the stationary T is that it draws to one side the incisors, unless the long-band is drawn back very evenly on both sides.

Fig. 393, F, illustrates (enlarged view) a sliding T-

[1] "Dental Cosmos," June, 1878, p. 308. [2] Devised in 1879 (Hall case).

piece, also two of the proper size, P, P′. These are composed of three parts, a rectangular ferule, in shape corresponding to a transverse section of the middle portion of the long-band, an interdental piece (to rest between the central incisors), and a flaring piece to rest on the lingual surfaces of the same teeth. These are all made as small and delicate as the case will permit, so as to avoid inconvenience, and in order to be strong in all parts are of rolled wire. The ferule is first made to fit loosely yet snugly on the long-band, after which the other two parts are added. When completed the T-piece is slided on the long-band and then the end nut is soldered to it at right angles.

FIG. 394.—String Drag-screw (A).

Occasionally a string together with a screw can be made practicable. Such fibrous connection with a short-band is shown in Fig. 394. The bar has a hole in one extremity for attachment of a string, the other end of which is fastened to some tooth to be moved. The device consists of a flat piece of wire, a nut and a screw; the latter being anchored to an anchor-band.

Ear-pieces.—For preventing devices made upon the principle of clamp-bands or ferules from slipping down upon the gum, ear-pieces should be made upon them at the time they are cut from the strip, or else soldered to them afterward. The latter plan is the more economical, and if the lap is not left too thick, it will serve as well. The material for ears must be ductile; therefore, they should always be made of rolled wire (annealed), sufficient in thickness to prevent them from straightening when power is applied to the anchor device. If they are made of plate they are very liable to break in bending. Such ears on clamp-bands should not be bent upon the teeth before the clamp-band has been fixed upon them, and then it is often well to allow them to remain (unless they interfere with the antagonism) for several hours and until the teeth assume their fixed relations to each other in the anchor-band.

Fig. 395.– Plain, Hooked and Stapled Ferules.

Anchor Ferules.—Ferules for banding teeth for the purpose of holding or for attaching other apparatus are made of gold or platinum plate. If of gold it may range in quality from 18 k. to pure, but should not be lower than the former, as it is difficult to solder and is liable to oxydize. If of pure gold, the ferules may be somewhat thicker than if alloyed. These devices are constructed as follows: Having rolled the plate to the desired thickness, usually from 32 to 34, it is cut of suitable length and breadth to extend around the tooth or group of teeth to be feruled and also to include mainly the length of the crown. These dimensions are ascertained by curving the plate and placing it around the teeth. It is well to have the ends overlap when soldered if necessary to be very strong, but if well soldered it will not easily break, if not overlapped.

Fig. 396.
Fig. 397.

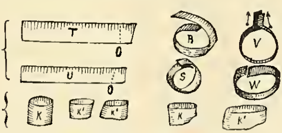


Fig. 396.—Ferule Material; T, U, strips before being rolled; R, V, S, W, the same rolled.
Fig. 397.—K, K', Appearance after being soldered.

Soldering Ferules.—Whether ferules are to include one or several teeth they are all made by the same process, different stages of which are shown in Figs. 396 and 397.

Having made a scratch line, O O, in an approximately correct place, R, the strip is removed from the mouth and cut, and then replaced on the tooth or teeth, to be again marked, S, but accurately. Having cut it to the scratch-line (O), whether it be directly transverse to the strip, O in T, or slightly diagonal to it, as O in U, it is again removed and cut, the line of cut of course depending upon whether it is desired to have the ends meet or overlap. The strip is then placed in wire "tongs" or a "nest," or any delicate device suitable for holding it in place; then, having wet the margin of the ferule-strip with an aqueous solution of muriatic acid, or borax pulverized in water on ground glass, lay on the seam a small piece of solder, 18 k. for pure gold and 14 k. if 18 k. gold, and hold it over the spirit lamp until the solder melts, then drop the ferule into water. The shape of the ferules, whether cylindrical, K, or conical, K′, depends upon the direction of the scratch-line O,O.

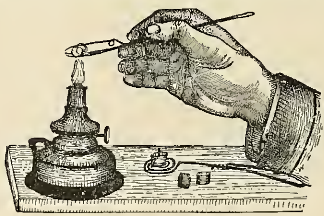


FIG. 398.– Soldering a Ferule.

Fig. 398 illustrates the soldering process. If a staple or a lever on the ferule is desired, drill or punch a hole through the ferule (best located in the overlapping portion) of the size of the wire. It is now ready for the wire staple or wire lever. Through this hole one arm of the staple or one end of the lever is then set, and soldered in place as before explained. If skillfully done, the same quality of solder as used in soldering the ferule first may be used this second time. Although only one arm of the staple rests in the hole, the other is soldered equally firm at the same time. The object of resting one leg of the staple in a hole in the ferule is to hold it in place more easily while being soldered. For staples or levers platinum wire is generally better than gold, as it can be more easily bent to any desired angle while in the mouth, and made to remain so, while gold being more elastic springs out of place. The size of the wire should correspond with the force to be applied. To bend a wire lever the ferule extremity should be firmly held by one pair of forceps, while the other extremity is bent by another pair.

Fig. 399.

Fig. 400.

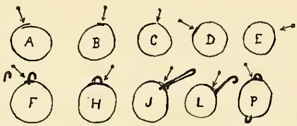


Fig. 399.—Showing (edgewise) the plain Bands before and after being Soldered.
Fig. 400.—The different stages of the application of Staples and Levers.

Fig. 399 illustrates the several stages in the process of soldering ferules. In this figure (which represents them edgewise), A illustrates a ferule cut with the lap, B, the same underlapped ready to solder, and D, the same after being soldered; C shows a band to be soldered without being lapped, E the same after being soldered.

In Fig. 400, F shows the insertion of one arm of a staple as it appears ready to be soldered; H, the same after being soldered; J, a ferule with a wire lever placed ready to be soldered; L, the device completed and the wire bent in the form of a hook. P shows a ferule having two staples, one in the lap, the other in single thickness.

Wire tongs and nests.—For holding ferules and such small things as nuts and clamp-bands, etc., for soldering, there is nothing superior to steel wire, which can be bent in a few minutes into any shape desired. This wire is usually about the size of a small pin.

Fig. 401 illustrates a group of various sizes and forms of such holders, a majority of which are represented as hold-

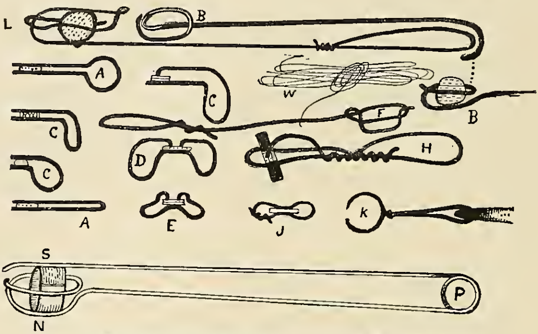


FIG. 401.—Wire Tongs and Nests for Soldering small Regulating Devices.

ing pieces ready to be soldered. A, H, C, D, E, J are modifications of short tongs intended to hold parts together while being held over the flame by a pair of tweezers, (see K). Longer tongs-like implements, such as are illustrated by B, B, F, H, are occasionally convenient, but better than all is a spring plier nest, such as shown by L, or by S, N, P, which, if made six inches in length, can be held by the other extremity without inconvenience from heat. Hair-wire, W, is often useful for binding parts together before soldering.

Clamp-band and ferule appendages.—Sometimes it is desirable to extend an arm from a clamp-band or a plate for attaching an elastic rubber ring to draw upon some distant tooth or to reach back so as to bear around some tooth posterior to the anchor-band to serve as additional anchorage.[1] Whenever it is desired to make appendages of any kind to anchor-bands, or ferules, it is simply a union of

[1] Lecture of Feb. 27, 1888. Pub. in "Brooklyn Medical Journal," July, 1888.

such parts by soldering. In Fig. 402, for illustration, are shown two devices of this kind. These extensions may be made from strips of 18 k. gold plate, or flat or round

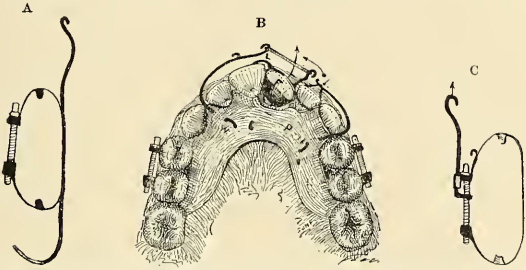


FIG. 402.—Extension Arms for Elastic and for Clasps (A). A, Fixed arm. B, Arms anchored to plate. C. Detachable arm.

wire, but a union of gold and platinum is sometimes preferable. As the parts are delicate, care must be taken to avoid melting them in soldering. The third cut shows a detachable arm anchored to the clamp-band screw, held in place by a tube soldered to the anterior band-nut.

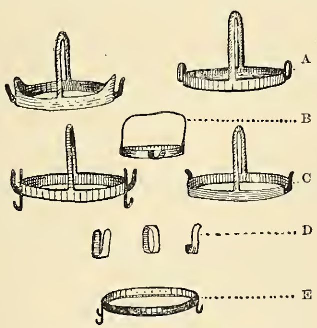


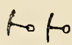
FIG. 403.—Gum-guard Rings Enlarged (A).

Actual Size (A).

Gum-guard rings, which are detachable devices for preventing regulating devices from impinging upon the gum.

are made very light and delicate. The band that extends around the tooth may be made of platinum, but 18 k. gold wire, rolled as thin as from No. 32 to 34, is superior. This is cut in strips about one-sixteenth of an inch wide, and when soldered one or two very small hooks, D, Fig. 403, are attached, and located as shown in exaggerated dimensions by A, B, C, E ; in proper size, shown at the right. To prevent this ring from slipping down upon the gum around bicuspid teeth, on which they are principally used, a narrow strip of thin flat wire (thicker than the band) is soldered to opposite sides of the band, as shown in B, and by the two lower figures at the right, or it may be small round wire as shown in A and C. For cuspids such guard rings have no bail, see E. This may be soldered with 16 k. solder, if done skillfully, but if the operator is not skilled in soldering, the device would be less liable to melt than if 14 k. solder were used. As a rule, in soldering such delicate devices it is well to use for the first soldering a quality that is about 4 carats less than that of which the device is made (say 14 k.), and the subsequent soldering about two carats less than the previous (or 12 k.), and for the third soldering still coarser quality, about 10 k., but this grade is liable to change color. Less than 10 k. should never be used.


FIG. 404.—Connecting-bands.


Draw Ts.

Connecting-bands.—These consist of two parts, the band to go around the tooth and a small staple or ring to connect it with the drawing apparatus. The bands should be very delicately made in order that they may readily pass up between the teeth and not be inconvenient to wear. They are made of 18 k. gold wire, rolled as thin as note-paper, and about one-sixteenth of an inch in width. The staple is made of round gold or platinum wire about the size of a small pin. As this tooth-band is so delicate, it is liable to melt while the parts are being soldered together, unless it be done with great care. An expert solderer will have no difficulty soldering 18 k. gold bands with 16 k. solder, and the staples with 14 k., but a beginner will find it much safer to use 14 k. to solder the band, and 10 k. for the staple. The strip is first cut to sufficient length to extend around the tooth and overlap about one-sixteenth of an inch, see Fig. 400.

Draw-T's.—The T is a very small but useful auxiliary to other devices, and consists of three parts, a labial bar, an "approximal surface" piece, and a ring. These draw-T's may be made of 18 k. gold plate, but wire is superior. The labial bar should be flat and of sufficient thickness to retain its shape, the approximal piece, (so-called because it rests between the approximal surfaces of the teeth,) which is also flat, may be thinner, but should be of sufficient strength not to break when drawn open. The ring is small, and is of gold or platinum wire of the thickness of a small pin. The first two parts are united with 14 k. solder, and the third part with that of 10 k. The rings may be soldered rigidly or they may be made to play loosely in a hole drilled for the purpose through the free extremity of the approximal piece. To hold these parts together for soldering, they may be pinned to charcoal or bound with steel hair-wire, or they may be held in wire tongs, such as shown in A, D, or H, Fig. 401.

FIG. 405.—Spur-plate (A).

Fig. 405 shows the construction of a spur-plate, for moving a partially erupted instanding cuspid. The spur, P, is made of thick gold plate bent at right angle and vulcanized into the rubber as shown. (See Part XV.)

CHAPTER XL.

JACK-SCREWS.

HEADS OF JACKS.—SCREWS FOR PUSH-JACKS.—JACK-SOCKETS.—ANCHOR-BANDS.—SWIVEL SCREWS FOR JACKS.—MATRIX WRENCHES.—STEEL WIRE.—WIRE SPRINGS.—LEVERS AND DRAUGHT WIRES.—GOLD AND SILVER SOLDER.—VULCANIZABLE RUBBER.—RUBBER TUBING.—LABORATORY TOOLS.—TAPS, SCREW PLATES, DIES, ETC.

IT has been thought that, in order to be strong, jack-screws must necessarily be large, but this is an error. A screw, the size of an ordinary steel knitting-needle, No. 15½ to 17½, is sufficiently powerful to move any tooth or any number of teeth. I rarely use a screw larger than this size even for widening the dental arch. For great strength, and to prevent destruction of threads, all that is necessary, as stated in a previous chapter, is to make the nut of sufficient length to include and bear upon a sufficient number of threads. From one-eighth to one-fourth of an inch of thread suffices for most cases, and one-half inch may be regarded as sufficient for all, so far as strength is concerned. The full power of a jack of any greater length, than can be obtained by this size and length of nut, would be imprudent, if not dangerous, but in manufacturing jacks it is often easier to screw-cut the entire length of the barrel of jacks than to cut only half of an inch and ream the remainder larger.

Heads of Jacks.—The heads of screw-jacks of the older style were confined to three forms: the broad crutch (the Longstreet and McCollum modification of the Westcott pattern); the flat (curved) edge; and the toy spinning-top form (Dwinelle forms), see Fig. 406. The forms which I use are modifications of these and are sometimes of alloy, but generally of gold; they are also much smaller. These modifications are illustrated in Figs. 407 to 411.[1]

FIG. 406.

FIG. 407.

FIG. 408. FIG. 409. FIG. 410. FIG. 411.

FIG. 406.—Large Jack-heads as found in the market.
FIG. 407.—Cylindrical Spindle-jack Screw-heads.
FIG. 408.—Curved Fish-tail Extremities of Jack-screws.
FIG. 409.—Straight Fish-tail Extremities of Jack-screws in two pieces, stationary.
FIG. 410.—Straight Fish-tail Extremities of Jack-screws in two pieces, movable.
FIG. 411.—Straight Fish-tail Extremities of Jack-screws in one piece.

The construction of these heads is so clearly shown in the figures that they need no further explanation.

FIG. 412.

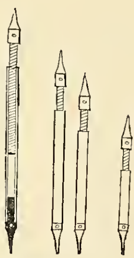


FIG. 413.

FIGS. 412 and 413.—Spindle-pointed Screw-jacks.

Screw-jacks such as shown in Fig. 412 on an enlarged

[1] Published in "Dental Cosmos," 1881 (A).

scale are made of jewellers' gold "hollow wire" or tubing, cut the desired length and threaded. It is not necessary to thread more than one-half of an inch, but it is easier, as before said, to thread the entire length of the barrel. The screw is made of gold wire of a size to suit the case. They are very strong if of No. 17 with about 80 threads to the inch. The spindle-head is made by filing down the extremities, then soldering on a short piece of "hollow wire," and filing and drilling it for a lever-key. The spindle-plug is made of a piece of wire tapered and soldered into one end of the barrel, as shown in black in the section view. Fig. 413 illustrates the medium size of jacks. For information concerning the making of screw threads, see Screws, page 412.

Fig. 414. Fig. 415. Fig. 416.

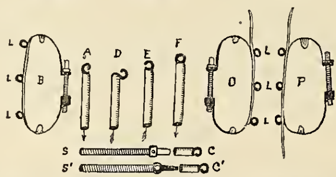


Fig. 417.

Figs. 414–417.—Showing the ring and hook plan of Attaching Screw-jacks to Anchor-bands (A).

To attach the screw-jack to the other parts of the regulating apparatus, rings or hooks made of 18 k. gold wire are soldered to different points along the sides of the band as shown in Fig. 414. If the two sides of the dental arch are on the same plane, the direction of force requires that jack hooks should be soldered to the ends, as shown in A and E; but if they are on different planes the hooks should be soldered to the sides of the barrel, as shown in D. The importance of placing these rings and hooks in different places on the barrel can only be appreciated by the experienced operator, who knows that firmness depends upon it. The size of these rings should be made to correspond with the rings in the anchor apparatus; in proportion as shown by L', L, L's, on clamp-band B, Fig. 414.

When it is uncertain whether open or closed rings are necessary on jacks, it is well to make them closed, as in F, Fig. 415. Such rings are made by curving the wire, so that the ends meet, when they are placed in contact with the end of the jack barrel, and soldered at the same time that the ring is united with the barrel. Should a hook be necessary, the ring is opened with cutting forceps.

Screws for push-jacks.—When a screw-jack is made without a swivel, the end opposite to the screw is made spindle shape or cylindrical, as shown in two sizes by S and S′ in Fig. 417. The key-bulb is made in two ways, by making the screw out of wire the size of the bulb, rolling the wire between a file and the bench-stub, and by soldering a small piece of thick "hollow-wire" to the wire as previously explained.

Jack-sockets.—Sockets for jack-screws are made of a short piece of tubing of proper size to fit the spindle nib. If the nib is tapering, as shown in S′, or cylindrical as in S, the inside of the socket C and C′ should correspond. This is done with drills corresponding, in shape and size, to the nibs.

Anchor-bands have been so fully explained in previous chapters of this work that it is unnecessary to dwell on the subject here, further than to say that when used for widening the entire arch, a stiff yet delicate piece of flat or half-round wire should be soldered to the lingual surface to stiffen the anchor-band. When it is desired to move only the teeth enclosed in the band the stiff bar need not extend beyond the clamp-band, but correspond with the length, as shown in B, Fig. 414. If it is designed to move more teeth, it may extend in one direction beyond the band (O, Fig. 416) or in two directions as in P (same figure). This bar, made of half-round wire or stiff plate, is soldered to the anchor-band, as shown. Fig. 418 shows their application.

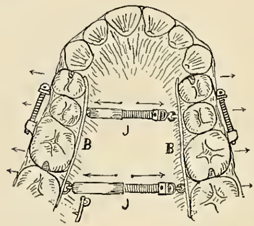


Fig. 418.—Jacks and Barred Anchor-bands Applied (A).

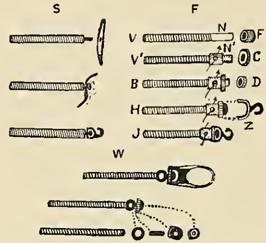


Fig. 419.—F and S,—Swivels for Jacks (A); W,—Swivels (Wilson).

Swivels for Screw-Jacks.—Swivels, as made by the author, are shown in detail at F, S, in Fig. 419. Having screw-cut the wire, V (as explained on p. 412), solder to the smooth extremity, N, a piece of tubing, F (about $\frac{1}{10}$ of an inch), leaving $\frac{1}{8}$ of an inch screw-wire protruding, as a neck for the swivel, upon which, having placed a wash-collar C in V′ (cut from thick plate, as shown in B), it is held loosely in position by a heading ring, D, soldered around the end of the neck, as shown at H. Upon two opposite sides of the wash-collar, C, is then soldered a U-shaped piece of round or flat wire, Z, having a hook soldered to it, as seen in J. To prevent the washer, C, from being soldered to the heading-piece, D, ochre is interposed. In S is shown a more simple but less valuable form. In W of the same Fig. is shown (unlettered) an excellent plan for swivels, devised by Dr. Cecil P. Wilson. It is made of seven parts, as seen in the diagram. In place of the ferule head for the key-hole (as shown by arrows in group F), a wire ring is used.[1]

Device for widening and turning.—Fig. 420 illustrates the main portion of a device for correcting a V-shaped dental

[1] Author's swivels (F and S), devised in 1873. Wilson's swivels (W), devised in 1888.

arch. It consists of two clamp-bands, having extension bars, B, B, a widening jack, J, and a draw swivel jack, D, with a T-piece. The T is made by soldering a straight piece of spring-gold wire to the end of the labial extremity of

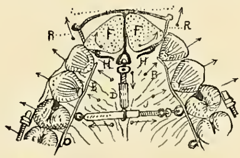


FIG. 420.—A T-piece for Turning Teeth (A).

the swivel tail. To apply this in practice, each extremity of the wire is bent to form a hook upon which is caught a ring of rubber, R, which is then stretched between the central and lateral, and again caught upon a hook, H, made of platinum wire soldered upon the lingual side of a ferule, F, cemented upon the tooth with phosphate of zinc, as shown. This wire, H, should be long enough to serve as a retainer when the teeth are sufficiently turned by being straightened so as to rest on the labial side of the lateral or cuspid.

It will be found advisable for any one who purposes to practice regulating to have duplicate parts such as screws, barrels, bolts, and rolled wire on hand; for in the ready use of such furnishings lies much of the secret of regulating teeth easily.

FIG. 421.—Matrix-wrenches (A).

Matrix-wrenches.—The box-wrench is one of my earlier devices, which since the quick-setting cement, phosphate of zinc, has come into use, has been superseded in my practice. Yet as the instrument may be deemed useful in some cases, its construction has been briefly explained on page 344.

Fig. 421 illustrates the several parts, the band, screw, barrel, and nut. The same proportions mentioned in regard to material for clamp-bands should be adopted in making this band. Every surplus or unnecessary portion of this device should be ground or filed away in order to reduce it to the minimum size, this depending upon the tooth or teeth to which the appliance is to be fitted.

Wire.—Steel wire is now frequently used in the art of regulating teeth; that which is preferred is known as piano wire, because it is of the best of steel and uniform in size. This uniformity is secured by its being drawn through draw-plates, a process which also gives the high polish; for dental purposes the wire should be free from flaws. Nos. 17 to 20 are the sizes generally used in "widening" operations. No. 20 is the most useful size for young patients, and as the age increases, the size should increase proportionably, some cases requiring as large a size as No. 17. In the use of steel wire, the great desideratum is to arrange it so that the pressure will be gentle and not act so violently as to cause inflammation, a point that is so difficult to attain that many dentists have abandoned its use. It is hard to manipulate by one not familiar with its properties. It will bear curvilinear strain, but not much angular bending; it is also easily broken by flattening or indenting it with a hammer, a change of form that is necessary to firmly anchor it in rubber plates. This change of form is made on an anvil. Gold is easier to work.

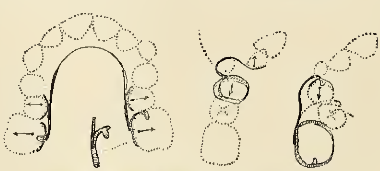


Fig. 422.—Gold Spring Wire Devices. (A.)

Wire Springs.—Fig. 423, A, shows one size of steel "piano-wire" spring, known in market as the Norton and Talbot spring. These are used in connection with cleft hard rubber plates for widening the dental arch. As a rule, the heavier wire can be better depended upon than smaller sizes. Dr. Talbot's coil is of spiral form (as in A), while the author's coil is concentric (as in C).

In a recent talk on Irregularities of the Teeth and their Treatment, Dr. Talbot thus described the construction of this device:

"The elasticity of the wire is increased by coiling it from one to three times around a mandrel. The mandrel is driven into the bench, and with one hand the wire is coiled about it as many times as required, the short end being held firmly by the other hand. The coil ends directly at the starting-point, and gives thereby the greatest elasticity and strength of arm power. When necessary, the long end of the wire can be bent with square pliers to make both arms on the same plane. The arms may be bent or cut at any length to suit the case in hand, and may be used in connection with a rubber plate, or with bands of gold or platinum cemented to the teeth with oxyphosphate of zinc."

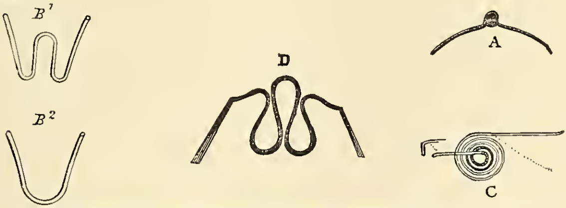


FIG. 423.—Different forms of Springs. The Headridge springs, B^1, B^2; Coffin's modification, D; Talbot spring, A: Farrar spring, C.

In England considerable use has been made of steel wire through the efforts of the elder and the younger Dr.

Coffin. Some of the varieties of springs made by these gentlemen and by Dr. Talbot are quite similar. The apparent distinctive feature of the Coffin spring is the absence of the coil, and the making use of the bowing principle instead. Fig. 423 D illustrates this principle in springs which Dr. Coffin uses. For widening the upper arch the anchorage of the spring is a hard-rubber plate, first made to cover the roof of the mouth, fitting the side teeth tightly, and into which is vulcanized both ends of the piano-wire, after which the plate is divided, as in the Headridge plan.

The length of wire required for such springs is from one inch to three and a half inches, and in its manipulation two pairs of pliers and a pair of clasp-benders are necessary. Care must be taken to avoid twists in the wire. The curves must be smooth and regular. The ends which are to rest in the rubber should be flattened with a hammer, and then bent while cold to form as sharp an angle as is possible without breaking them. They are then filed bright, and dipped into a copper cup of molten tin kept hot on a tripod, after which process they are proceeded with as in case of vulcanizing gold wire into rubber plates. To make the devices serviceable, the wire springs must be securely anchored to the plate so that they will not dislodge when force is exerted upon them, and when applied the force should not be powerful enough to separate the maxillary bones.[1]

Levers and draught wires for turning, drawing, or pushing teeth are various in form and size. Several of these are shown on a large scale in Fig. 424. They are made of round or flat wire, but round wire is generally preferable.

These may be made of steel, gilded silver, or of solid 18 k. gold; the latter is more satisfactory to patients. If it is desired to have the hooks rest stationary, the extremities should be filed or hammered flat, and the shape of the

[1] For further information on Springs by Coffin, Bonwill, Jackson, Angle, Headridge, and the Author, see Parts XV., and XVIII., Vol. 2.

staple or tubing into which they are to rest made to correspond.

The shape of hooks varies; as, for instance, curved, B, right-angled, I, fish-hook, E, and U-shaped, H. The figure

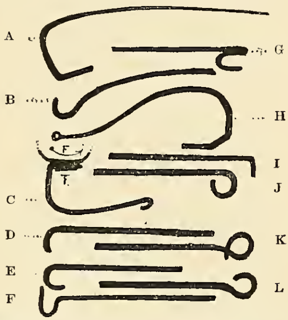


FIG. 424.—Different Forms of Wire Hook Levers, for Drawing and Pushing.

presents illustrations of the different forms.[1] These hooks are probably old to the profession.

GOLD AND SILVER SOLDERS.

As 18 k. gold plate is generally composed of gold, silver, and copper, it will be seen that a solder made of the same metals, that would be suitable, must be of lower grade. For artificial dentures a 16 k. quality is often used, but for regulating devices made of 18 k. gold, 14 k. solder is more advisable, because it will fuse so easily as to avoid melting the fixture; but this point is of more importance to beginners than to expert workmen. Skilled solderers will as easily manage the fusing of 16 k. solder on 18 k. as 14 k. At the present time 18 k. and 14 k. solder are the qualities

[1] The hook A and C, Fig. 424, was published in the "Dental Cosmos," July, 1886. (A.) I, is the peculiar form in Dr. Angle's devices (1886).

generally found in the dental depots, but a 16 k. quality can be easily approximated by melting together an equal quantity of each of these. Solders of this kind melt easily, but they do not flow readily over spaces. While this quality is well adapted to soldering heavy jewelry, such as finger rings, it is not so practicable, for the delicate work used in regulating devices, as 14 k.

The fusing point of these gold solders may be made to vary by a corresponding variation in the elements of gold, silver, and copper; but for our purpose a better solder may be made by substituting zinc for copper. This makes a solder that melts more easily than the other, and holds its color better, and though less fluid and requiring more care, when fused properly it is better for flowing across spaces between parts of devices. The proportions of these elements recommended are as follows: Pure gold, eighteen grains; silver solder (which in weight is two parts silver and one brass) five grains; and zinc, one and one-half grains. This makes a close approximation to 18 k. solder, which is suitable for soldering devices made of pure gold; but for soldering 18 k. devices this solder should have a larger proportion of zinc. A very satisfactory solder of this quality is made as follows:—

Pure gold..................................	9 grs.
Silver solder..............................	$2\frac{1}{2}$ "
Zinc.......................................	$2\frac{1}{2}$ "

To manufacture solder: place the gold in a small crucible or on a piece of a crucible, and then melt it and add the zinc, but be careful and not heat the composition too much, or it will burn out the zinc; and do not attempt to prolong the heat in an effort to make it homogeneous. But to insure this, first let it cool, then forge and roll thin, cut in pieces and remelt. Add borax in excess at every heating.

The following are different formulæ for making solder:—

18 K. GOLD SOLDER, SUITABLE FOR 18 K. HEAVY PLATE.

Pure gold	18 grs.
" silver	3 "
Brass wire	3 "

Use borax as flux. Melt the gold and silver. Add the brass when taken from the fire (gold and silver being at red heat). Stir in the brass, which will soon melt.

14 K. GOLD SOLDER FOR 18 K. GOLD.

Gold	4 parts.
Silver	½ "
Copper	¼ "

This is one of the best solders for clamp-bands and other devices of similar dimensions.

12 K. SOLDER FOR 16 K. GOLD REGULATING DEVICES, OR FOR SECOND SOLDERING OF 18 K. GOLD.

Gold	4 parts.
Silver	¾ "
Copper	¼ "

10 K. SOLDER FOR 14 K. GOLD DEVICES, OR FOR THIRD SOLDERING OF 18 K. GOLD.

Gold	4 parts.
Silver	1 "
Copper	½ "

SILVER SOLDER FOR PURE SILVER OR AMERICAN COIN.

Fine silver	24 parts.
" copper	8 "
Brass wire (fine quality)	4 "

Melt the silver and copper together to a low red heat; add brass.

In conclusion it may be well to remember that, while circumstances may render it necessary to make solder, it is much more convenient to buy it whenever obtainable at dental or at jewelry furnishing depots; and of all the different qualities given for soldering such regulating devices as recommended by the author, 14 k. and 12 k. are the most useful.

Vulcanizable Rubber.—Of the methods of procedure with rubber, in the manufacture of regulating appliances, little need be said, as the rules for making artificial dentures will apply to this class of devices. One point, however, may be mentioned, the avoidance of oxidation of metals in making those portions of the devices that are to be anchored in the rubber. The metal most necessary to guard against using is naked silver, which cannot be firmly anchored without first heavily tinning it. Gold and platinum are metals that can be firmly held, but steel wire may be dipped in molten tin while red hot, and thus be rendered practicable in vulcanized rubber. Of course, there is no union between rubber and metal, nothing but contact, therefore, all portions of metallic devices which are intended to be anchored in rubber should be made flat and roughened, in order to prevent them from working loose, as round wire is very liable to do without this precaution.

FIG. 425.—Two sizes of Rubber Tubing.

Rubber Tubing.—Fig. 425 illustrates the two sizes of rubber tubing most suitable for rings to use as elastics for moving teeth. That of French manufacture is at present regarded the best. When needed, all that is necessary is to cut off a small circular piece of sufficient width to be strong enough for the purpose. This ring is fastened to some portion of the anchor devices, or woven around and between the teeth in such a manner as to draw them in the direction desired.

As rubber soon weakens by age, it becomes worthless for this purpose after a few months, therefore in buying rubber tubing, it is necessary to select that which is new and strong, having no weak seam-like place. To determine this point, place a short piece on the beaks of straight forceps, and then open the beaks, and note the strength of the ring before it breaks. Package rubber elastics are sometimes superior to rings cut from tubing.

LABORATORY TOOLS.

The tools used for making regulating devices differ according to the judgment of different dentists, but there are some which are used for plate work and are equally adapted for regulating apparatus, that are absolutely necessary in any well-supplied laboratory and there are others necessary for gold devices which are not often found in dental laboratories. These include the different tools for making screws and nuts ; an anvil, hammer, bench-vise, hand-vise, fine files, delicate shears, pincers, pliers, forceps, etc. Then there are auxiliaries, which are used in polishing the devices before placing them in the mouth, such as small felt wheels, brushes, etc. A few of these will be briefly mentioned.

Taps, screw-plates, dies, etc.—As mentioned while describing the making of screws, there are different tools for such purposes. The ordinary kind consists of a steel plate with various sizes of screw-cutting holes and several taps for threading nuts and tubes corresponding in size. The must convenient tools for making miniature screws and nuts, however, are similar in form to those used in the manufacture of larger sizes. A set of these includes taps, dies, wrenches, and tap-holders.

Fig. 426 illustrates what is known as the Elterich set as they appear arranged in a box. They can be obtained from jewellers' supply dépôts.

The taps for nuts are made by hand, of the best material, and carefully finished. They are ground out and relieved, so as to make a perfectly finished thread at one cut, and

FIG. 426.—Set of Tools for making Screws and Nuts (Elterich).

FIG. 427.—Forceps for holding taps and paper disk mandrels.

can be backed out from the work without breaking. They are operated by an adjustable tap-wrench, which may be of awl-handle shape, as in Fig. 428, or auger-handled, as illustrated in Fig. 430. The form of screw is shown in the same figure.

FIG. 428.—Awl-handle Tap-holder.

FIG. 429.—Die-holder.

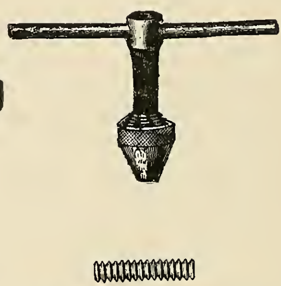


FIG. 430.—Auger-handled Tap-wrench and the form of screw.

The best dies are made exact in size, yet capable of being adjusted so as to meet the changes in wear, see Fig. 429. They cut rapidly, and are so durable that more than five

FIG. 431.—Tap, Enlarged to show the form.

hundred screws can be made with one instrument. If gold wire is used, they should cut and finish the work with one operation, and especially is this true of very small sizes of threads.

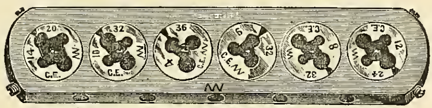


FIG. 432.—Adjustable Die-plate.

A manufacturer informs me that he expects to make a plate, holding six dies (Fig. 432), and another for a lathe (Fig. 433).

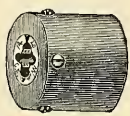


FIG. 433.—Die for Lathe.

The dies in the adjustable plate can be regulated and remain in the holder until worn out. The convenience of having the dies adjusted to suit the taps without removing them will be appreciated by mechanics. The dies are placed in the recess of the holder, and each is held in position by two screws; either screw can be placed in the slot for enlarging the dies, and the other in the indentation on the side for reducing the size.

In arranging the screw-die shown in Fig. 429, it is placed in a recess in the middle of the holder, and held in position by three small pointed steel set screws, as shown. The two side-screws enter small indentations in the sides of the die and the centre-screw in the slot. When, from long use, the die wears, the size is reduced by loosening the centre-screw and tightening the two side-screws. If a screw slightly larger is required, the die can be widened a little by loosening the side screws and tightening the centre-screw.

It should be understood that the tools manufactured for the use of jewellers make somewhat smaller threads than are best for dentists' purposes. Screws and nuts made with them are, however, serviceable when carefully used, but it requires caution in "entering them" in order to avoid injuring the delicate threads. The notion that with larger threads a stronger draught can be secured is not always correct, for, as before said, when speaking upon screw making, what is gained by a smaller number of large threads, is attainable by a greater number of small threads. Still, the collections of calculi around the latter are a drawback to their use.

The approximate dimensions of the taps and dies of this set, and the screws and nuts, and number of threads per inch made by them, are as follows:

TAPS AND DIES FOR JEWELLERS.

Size of Wire.	Diameter in Decimal Parts of an Inch.	No. of Threads to Inch.
2	.0775	64
1	.063	72
D	.07	80
C	.058	100
B	.0475	120
A	.04	140

The following figures illustrate various other kinds of tools necessary to the equipment of a dental laboratory.

FIG. 434.—Plate Shears.

FIG. 436.—Steel Hammer.

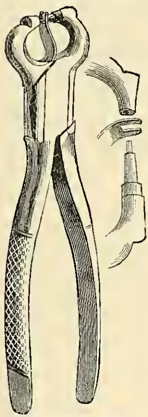


FIG. 435.—Punching Forceps.

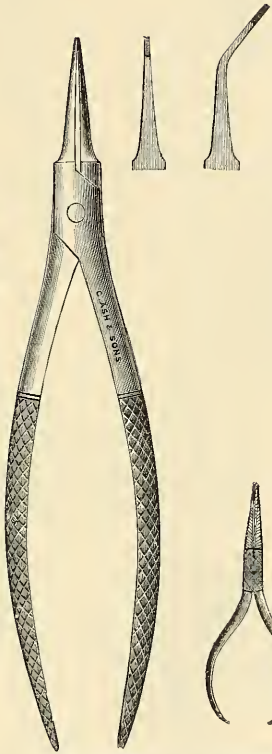
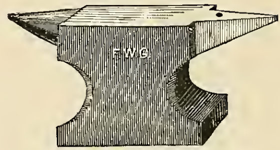
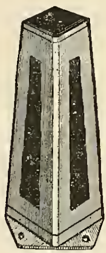


FIG. 437.—Pliers for Bending and Holding small Gold Devices.

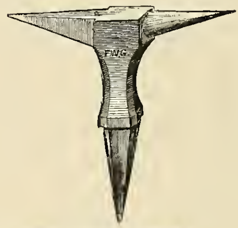
Light Anvil for Moulding Delicate Devices, Modification of the Knapp Crown Anvil.



Toy Anvil for Heavy Work, such as Flattening Wire.



Bench Anvil.



Bench Anvil for Lead Base.

FIG. 438.—Four Modifications of Forms of Anvils.

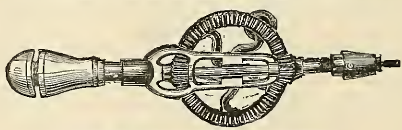


FIG. 439.—Hand-machine for Drilling.

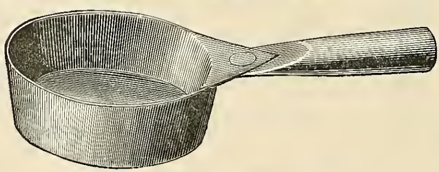


FIG. 440.—De-oxidizing Pan.

FIG. 441.—Hand-polishing Brush.

Fig. 442.—Gold Gauge-plate for Measuring Plate and Wire.

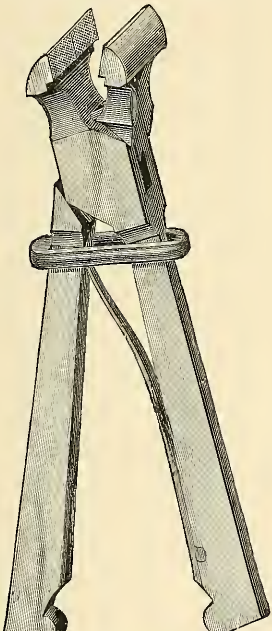


Fig. 443.—Hand-vise.

Fig. 444.—Tweezers.

Fig. 445.—Wrench Key.

PART IX.

Philosophy of the Application of Force.

CHAPTER XLI.

POSITIVE AND PROBABLE MECHANISM.

FUNDAMENTAL RULES.

THE movements of the screw or the cogged wheel are typical of positive mechanics, and those of the drum and belt of the probable. The former are as certain and calculable as the law of gravitation; while the latter are not absolutely certain and calculable, because the belt may slip.

All machines, as, for instance, steam-engines, the value and success of which depend on exactness in all the details

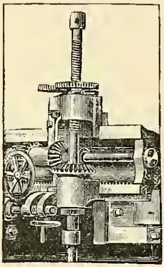


FIG. 446.—Positive Mechanism.

for co-ordination of motion, are built upon positive principles; while spinning-wheels and similar machines are generally, if not always, built on the probable plan, by the use of belts and springs. There is a third class of machines in which both these principles are combined. These are mixed mechanics.

The question as to which of these principles is best to use in the construction of apparatus for moving teeth, and how best to use them, has been sufficiently discussed in previous chapters. It may be summed up here under the following fundamental rules.

Rule 1st. Mechanical appliances for correcting irregular teeth for children under ten years of age may be constructed upon any principle that can be practically applied, whether

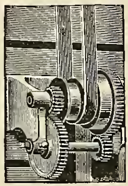


FIG. 447.—Mixed Mechanics.

the force acts continuously or intermittently, provided it is not great enough to cause pain.

Rule 2nd. Mechanical appliances for correcting irregularities for patients over ten or fifteen years of age, especially difficult cases, may be constructed on similar principles; but for accuracy of movement and to insure against giving pain, they should, if possible, be made on the principle of intermittent action.

Rule 3rd. Mechanical appliances should be so constructed that the wearing of them will cause as little inconvenience as possible to the patient.

Rule 4th. Apparatus should be as delicately and simply constructed as is consistent with the capability of doing its work with certainty, but complexity should not be regarded as an objection when by it the operation can be conducted more scientifically.

Rule 5th. Appliances should be made accurate enough to render it unnecessary for the patient to always apply to the dentist whenever re-adjustment is necessary.

As the bringing of improperly located teeth into esthetic order does not constitute the whole art of correction of irregularities, but involves the holding the teeth in place for some time afterward, it necessarily follows that devices to prevent them from going astray again naturally belong to the mechanics of the art, and might properly come in here for treatment, but as these devices have been described at length in Part VII., it is not necessary.

CHAPTER XLII.

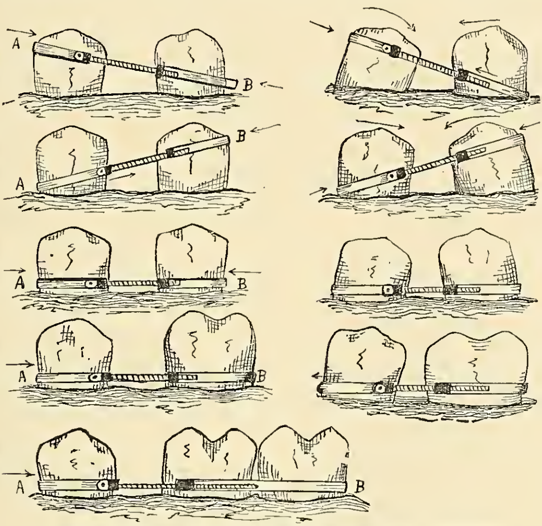
PHILOSOPHY OF THE APPLICATION OF APPARATUS.

DIFFERENT LINES OF FORCE.

THE apparatus used in regulating teeth should be so applied as to prevent them from rising or falling in their sockets. It is not always easy to determine the method of doing this, because the teeth to be moved, and the anchor teeth to which the mechanism is secured, are so arranged that there is little opportunity to place the anchor apparatus exactly on the proper line or relation to the point of attachment on the tooth or teeth to be corrected. The unfavorable shape of teeth when cramped together by clasp-springs or clamp-bands, improperly applied, may also, possibly, cause them to rise. As, in nearly all operations, the movement of teeth depends upon their being tilted, it is, for the same reason, somewhat difficult to prevent the anchor teeth from rising. If one end of a clamp-band should be secured around a tooth near the gum, and the other end at a point close to the antagonizing surface of a similar tooth, the firmness of the point near the gum would be greater than at the other end ; because, the closer the socket resistance, the shorter the leverage.

The effect of this would be as shown in an exaggerated degree by the accompanying diagrams, which represent wooden blocks resembling teeth in shape, set in the ground and connected by clamp bands, arranged to cause the force to act in the direction indicated by arrows. If the bands should be applied as in Fig. 448 the result would be as shown in Fig. 453, or as Fig. 449 compared with Fig. 454. At the same time at which the force was applied at A (Fig. 448) there would also be at B a tendency to rise, because the force exerted from the point A would have a lifting influence. This tendency to rise may generally be counteracted in one of two ways, where the teeth are equal

Fig. 448. Fig. 449. Fig. 450. Fig. 451. Fig. 452. Fig. 453. Fig. 454. Fig. 455. Fig. 456.



Figs. 448–456.—Result of force may depend upon the point of application.

in resistance,—first, by placing the bearings around corresponding points of the different teeth, so that the line of force would be nearly or quite parallel with the surface of the gum, as shown in Figs. 450 and 455; or by selecting for an anchorage a tooth having a socket of greater resistance, which implies a larger tooth than the one that is to be moved, as illustrated by Figs. 451 and 456, or a greater number of teeth, as shown in Fig. 452.

For absolute security against the rising of teeth, the force should, if practicable, be made to draw at an angle not exceeding ninety degrees from the apical end of its longer axial diameter; and, better still, not to exceed ninety degrees from the apical end of the long surface-line of that side of the root which is in advance while being moved; for it is impossible for a force applied at right angles to the surface of anything to make it move in a vertical direction.

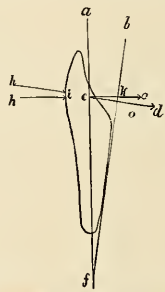
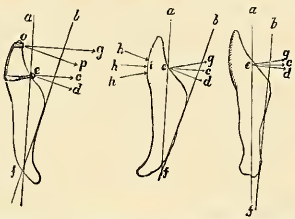


FIG. 457.—Effect of different Lines of Force geometrically illustrated.

Fig. 457 illustrates the different lines of forces above referred to; *a f* represents the longer axial line of the tooth; *f e c* an angle of ninety degrees. A lifting force applied from the point *a* at the crown extremity of the longer axial diameter, *a f*, will tend to raise the tooth directly from its socket; while a force applied from the direction of *d*, at right angles (at the point *o*) with the surface-line, *f b*, cannot, if the root be straight, cause the tooth to rise in its socket; but if it be applied at any angle greater than *f o d*, or ninety degrees, as *f k c*, it brings about an approach to the former condition, and will tend to raise the tooth.

Although the angle *f e c* on the longer axial line, *a f*, is only ninety degrees, yet as the angle, *f k c*, is greater than *f o d*, and as the tendency to rise is caused by the tapering of the root (as seen in the line *f b*) and the line *c k* corresponds with the line *c e*, which is the line of draught,—a force applied from the direction of the point *c*, or at any point above *c*, will tend more or less to raise the tooth in its socket; the result depending on the degree of the angle at which the force is acting.

Experience, however, teaches that though this is theoretically true, still, owing to the resistance of the socket attachments or the peculiar shape of some roots, teeth will generally permit a draught to be made at an angle somewhat greater than ninety degrees with the advance surface



FIGS. 458, 459, 460.—Philosophy of Application of Force upon Teeth having Crooked Roots.

line of this portion of the root; but it is not prudent to trust too much to the resistance of socket attachments.

The extent of this departure from strict geometrical theory, of course, may depend on various circumstances, such as the duration of the applied force, the length of the root, and the degree of firmness of the attachment between the tooth and the socket; and, still more, on the shape of the root.

If the teeth require pushing apparatus to move them, the force should be applied on similar lines, but from the opposite direction. This will be easily understood by reference to Figs. 458, 459 and 460, in which, owing to the difference in shape of the roots, it is evident that the force may (and sometimes should) be differently applied.

For a root shaped as in Fig. 458, the attachment of a draught from *c*, should be made nearer the cutting edge of the crown than *e*, say at *o*, than would be necessary with teeth having roots shaped like those in Figs. 459 and 460, as these teeth would not be liable to rise within the socket, even if the forces were made to draw in the line *e g*. Of course, it is not possible to ascertain the exact shape of the roots, and experiment must be relied on more or less in all treatment for regulation.

CHAPTER XLIII.

ANCHORAGE RESISTANCE OF THE SOCKET TISSUES.

RELATIVE ANCHORAGE VALUE OF DIFFERENT TEETH.[1]

A KNOWLEDGE of the power of anchorage resistance is of great importance in operations for correcting irregularities. In the widening of the dental arch, the opposite teeth are mutual supports, having an action on each other which renders them advantageous for anchorage. In fact, they may be relied on for any and all movements of teeth in this class of operations if the sockets are in a sound condition.

In cases where the front teeth are jumbled together, as, for instance, where the incisors and cuspids overlap each other, the posterior teeth usually afford sufficiently firm anchorage to effect their correction, provided the operation is carefully watched, so that too great a degree of force is not applied at any one time. A proper degree will move teeth through the alveolar tissues; too great a degree is liable to raise them from the socket in a manner similar to that in which a turn-key would lift them. (See Miscellaneous Suggestions, Part XX., Vol. 2.)

The correction of the deformity caused by abnormal protrusion of the six upper front teeth sometimes requires a greater degree of anchorage than the posterior teeth afford. This circumstance renders it necessary to exercise judgment

[1] Published in "Dental Cosmos," July, 1886, p. 405.

and care, for, as has been stated, the hardness of the alveolar process varies considerably at different ages, and in different persons even of the same age. This circumstance, of course, renders variable the value of posterior teeth as anchorage. In other words, the anchorage resistance of teeth has a limit within which apparatus may be used successfully without danger, outside of which it is at least necessary to proceed cautiously. This limit also depends somewhat upon the point at which the mechanism is attached; for instance, when the draught is made from the necks of the teeth, the degree of anchorage resistance is greater than when made from a point near the grinding surfaces, for in the latter position the crown acts as a longer lever upon its socket, as explained in the preceding chapter.

According to my experience, the degree of anchorage resistance usually to be found in bicuspids and molars may be approximately stated thus:

1st. The anchorage resistance of two bicuspids is sufficient to move one cuspid, but as the resistance in both opponents is nearly equal, they are equally affected, and if made to approach each other by a clamp-band, will meet at a point about equidistant.

2nd. The anchorage resistance of one molar is sufficient to move the first bicuspid into the place of a missing second bicuspid.

3rd. The anchorage resistance of one bicuspid and one molar combined is sufficient to move one cuspid and one lateral incisor, if acted upon separately.

In other words, assuming that the first bicuspid is extracted to make room for a cuspid, (which is sometimes the best plan of treatment,) the anchorage resistance of the second bicuspid and two molars (fully developed) is generally sufficient to move the cuspid back against the second bicuspid, and is sufficient afterward to draw sidewise the lateral incisor, and, generally, a central along the ridge, about an eighth of an inch; but the resistance of the sockets of side teeth is so variable that the calculations founded on it are not given as being absolutely reliable. Experience teaches that, in correcting protruding upper teeth, the anchorage resistance of two molars is sufficient to draw a first bicuspid into the place of an extracted second bicuspid, and for drawing a cuspid into the place of a first bicuspid, and sometimes sufficient for drawing a lateral partially to place. But, unless the alveolar process is unusually favorable, this anchorage is not often sufficient to move the centrals into place, and resort must be had to the use of outside devices bearing upon the back of the head. If, however, the side teeth are banded collectively and are set in phosphate of zinc cement, or each tooth is enclosed in a closely-fitting gold thimble-crown, and they are all soldered together after the Barrett plan, (Fig. 287, p. 332,) the anchorage is rendered firmer; this is because in this manner these teeth are in a measure prevented from tilting.

CHAPTER XLIV.

RETENTION OF DEVICES BY UNAIDED IMPINGEMENT.

REASON WHY AUXILIARIES ARE SOMETIMES NECESSARY TO HOLD ROOF PLATES IN PLACE.

THE dental arch, as explained in Part IV., may be widened by bending the alveolar ridge or by causing its absorption on the buccal sides of the teeth. This may be accomplished by the use of roof plates, made continually operative by the addition of wooden pegs set in the edge, or by cleft or divided plates, the parts of which are connected by springs, or else by devices operated by screws. The question as to which plan is best depends upon the circumstances of the case and qualifications of the dentist; but whatever plan is adopted, success, so far as the movement of the teeth is concerned, depends very much, if not wholly, upon the degree of firmness of the device upon the teeth.

There are several methods of retaining plates in position: 1st. By impingement alone against the teeth; 2d. By lodgment under wart-plugs in cavities in the lingual walls of the side teeth; 3rd. By means of points between the teeth; 4th. By binding the plate by means of strings or wire; 5th. By gold clasps; 6th. By clamp-bands or ferules placed independently around some of the side teeth after the plate has been inserted; 7th. By clamp-bands vulcanized to the plate, the author's favorite plan. (Fig. 89, p. 219).

More than one of these different means of holding apparatus in place may be used in combination ; but, to explain more clearly the philosophy of applied force and the results of its application, the first-mentioned method should be understood, after which the reasons for their necessary combination in many cases will become apparent. Failures in operations for widening the arch simply by the use of plates are frequently due to disregard of the laws of action and reaction of force; it therefore seems proper that a chapter should be devoted to the subject, to explain it in a mathematical light.

The usefulness of any mechanism held in place simply by impingement, such as the ordinary screw-jack, roof-plate, or any form of unaided anchor-plate, depends upon the relation (direction) of the applied force to the plane of the surface of the teeth acted on, and it may possibly be influenced to a slight degree by the plane of the socket resistance to the root of the tooth.

The science of regulating teeth by artificial appliances depends upon the laws which govern the action of two or more slowly-moving solids remaining in contact; differing from the principle of blow and rebound, caused by suddenly applied force and rapid motion, as seen in the playing of billiards. To differentiate these relations, more clearly, let us examine them side by side under the form of two propositions.

For convenience of demonstration, the following terms will be used:

1st. *Applied force* is the force applied by the mechanism or its equivalent to the teeth to be moved.

2d. *Point of contact* is the point (D, Fig. 461) at which the force of a mechanism is applied to the tooth to be moved.

3d. *Plane of applied force* is the shortest line between opposite points of contact of the mechanism across the dental arch (D D, Fig. 462).

4th. *Plane of surface resistance* is the plane (B B, Fig.

461) of that portion of the surface of a tooth at which force is applied.

5th. *Perpendicular line* is a line (O O, Fig. 461) corresponding to the long axis of the tooth.

6th. *Plane of the socket resistance* is the socket surface, against which the tooth bears by force of the mechanism.

The line (R D) is a curve, the radius of which is equal to the distance between the apex and the "point of contact," as D. This line (R D), although slightly curved, on account of the greater movement of the crown than the

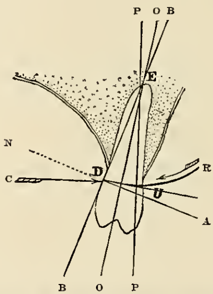


FIG. 461.—Showing Philosophy of Forces.

apical portion of the root, is nearly parallel with the short axis (D U), and may or may not correspond with a line (D A) drawn at a right angle to the surface-plane (B B) at point of resistance, depending upon the shape of the crown, as will be demonstrated later.

From these definitions, it will be seen that the "surface-plane" differs from "plane of socket-resistance;" and while it is possible that both lines of force may be in nearly the same direction, under the conditions shown in the middle diagram (Fig. 468) of the group on page 475, under others, as shown in the last diagram of same group (Fig. 475), they may be quite different.

The following figures afford a still clearer demonstration of the different directions of force.

Fig. 462 represents a section of the upper jaw, made through the bicuspid teeth. The arrows *o c p* indicate different directions of force, often attempted in the widening of arches. D L indicates the transverse diameter of the

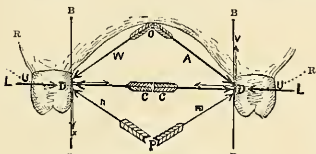


FIG. 462.—Different Lines of Force on Teeth.

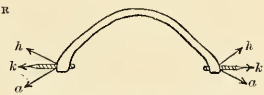


FIG. 463.—Different Lines of Force on a Plate.

tooth, which in this figure also corresponds nearly with the plane of socket resistance D R, as well as the plane of applied force, D D.

Fig. 463 represents a section of a peg roof-plate, indicating by arrows the different directions of applied force, proper and improper. Let us now state the two propositions before referred to, and note the steps in their solution.

FIRST PROPOSITION.

In order successfully to widen the arch by devices held in place by impingement alone, the direction of applied force should be on the plane of the shortest line between the opposite points of impingement.

This does not imply that the fixtures must be straight rods or flat plates; for, if the points of impingement in the arched plate, Fig. 463, should be at K K, the force would be as truly on the plane of a straight line as if the plate were flat as from D to D, Fig. 462.

The truth of this statement will become more apparent on comparing the effect of the force applied in the direction of *k k*, with that given in the direction of *h h*, which would force the plate from the roof of the mouth, or with that given in the direction of *a a*, which would cause the impingement points of the plate to slide down and off the teeth. To render the matter clearer, these statements will now be taken up and considered comparatively. See Fig. 462.

ESTABLISHED PRINCIPLES OF SLOW MOTION.

First Rule :—Should a body moving slowly from the direction of C be in contact at right angles with the plane of a solid at its centre of equilibrium of inertia (as at D), the pressure would not only be forward on a direct line DL, but would also re-act backward upon the line of its path (D C) Fig. 462.

Second Rule :—But should the direction of a slowly-moving solid be any other than at right angles, as P D, or O D, or at one side of its centre of equilibrium of inertia, the onward as well as the backward pressure would be bent out of direct line, and the body would glide along the surface-plane B B, in the direction corresponding to the onward side of the obtuse angle, as D V or D X.

ESTABLISHED PRINCIPLES OF RAPID MOTION.

First Rule :—Should a solid (at C, Fig. 462) under rapid motion meet at right angles the plane (B B) of another solid at its centre of equilibrium of inertia (as at D), the momentum of the moving body (C) would either carry it onward, in a straight line, pushing the other before it, or it would rebound upon its own track.

Second Rule :—But, should a rapidly-moving solid (as O) meet the plane of such a body at any other than a right angle, the path of the moving solid would either be more or less bent in its onward course, or it would rebound in an opposite angle, D P, or both results would occur.

The first column contains the rule which bears upon our subject; but as one end of a tooth is in a measure fixed in its socket, and as its movement generally hinges on or near its apex, and as the opposite end is freer, and the centre of equilibrium of inertia, or that balancing point which would enable the tooth to be moved directly forward bodily, is generally within the portion which is buried beneath the surface of the gum, some features of these rules of action cannot be strictly applied; still the principles involved in the proposition are sufficiently easy to comprehend.

In accordance with these statements it will be seen that while the increase of the force of a mechanism by means of screws so applied that it (force) will be in the line of the arrows *k k* (Fig. 463), it will practically cause retention of the mechanism by friction or impingement, the extension of screws pointing in the direction of the arrows, *h h*, will tend to force the plate from the roof of the mouth; or, if the plate is otherwise retained, the screws will creep along the surface of the tooth toward the margin of the gum. On the other hand, while the screws, if set in the direction of the arrows, *a a*, will not by their advancement draw the plate from the roof of the mouth, their points will slide along the surface of the teeth in the direction shown, rendering the device unserviceable. This statement as to screws will also apply to wooden pegs.

We will now examine the second proposition.

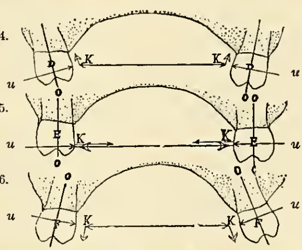
SECOND PROPOSITION.

The position and shape of the teeth govern the degree of applicability of the principles of the first proposition.

Fig. 464.

Fig. 465.

Fig. 466.



Figs. 464–466.—The Practicability of unaided Plates may depend upon the Position of the Teeth.

An idea of the philosophy of application of force to teeth in different positions may be obtained by comparing Figs. 464, 465, 466, which also represent different stages in the process of widening the arch. The arrows, K K, indicate the tendencies of plates applied in accordance with the rules of established principles of the first proposition, and show that, while an impingement-plate may be useful under the conditions exemplified in Figs. 464 and 465, it cannot be so when the teeth have assumed the position shown in Fig. 466. The latter condition, therefore, requires the use of auxiliaries in order to secure retention of the device.

ESTABLISHED PRINCIPLES AS TO THE RELATION BETWEEN THE DIRECTIONS OF FORCE AND THE PLANE OF RESISTANCE.

Rule First :—In cases where no great abnormality of the crowns exists, mechanical appliances depending on unaided friction or impingement *are* practicable when the line *u*, Fig. 464, drawn at right angles to the surface-plane of the tooth at the point of impingement, K, points *inside* of the plane of applied force, K K.

Rule Second :—But in similar cases, mechanical appliances depending on unaided friction or impingement *are not* practicable when the line *u*, drawn at right angles to the surface-plane of the tooth at the point of impingement K, points *outside* of the jaw surface of the plane of applied force, K K, as shown in Fig. 466.

To demonstrate more clearly these rules as to position and shape of teeth, let us refer to the nine following figures, 467 to 475, which are all modifications of Fig. 462, and represent corresponding sections of half upper jaws, showing by three sets of diagrams three corresponding positions of three different shapes of teeth.

Understanding what has been said as to Fig. 462, from a comparison of these three sets of figures, the truth of the second proposition becomes so evident as to need but little further demonstration. It is also obvious that, although the plane of socket resistance in the matter of raising or depressing teeth in their sockets, is worthy of consideration, it is not of so much importance in making calculations as to the retention of mechanical appliances as is the direction or inclination of the lingual surface-plane, B B, in relation to the plane of applied forces, C D. It also becomes evident that it matters little on which side of the lines A D the line R D lies, whether above, as shown in Fig. 472, or below, as in Fig. 473, as devices depending on unaided impingement are not much influenced by it.

While the duration of the usefulness of such devices de-

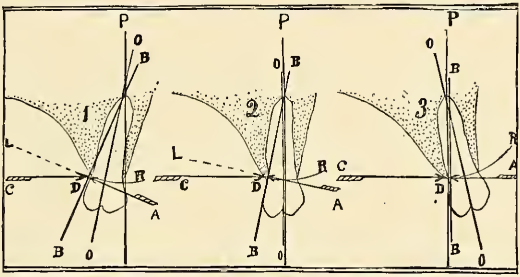


FIG. 467. FIG. 468. FIG. 469.

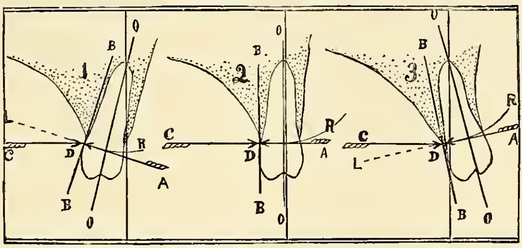


FIG. 470. FIG. 471. FIG. 472.

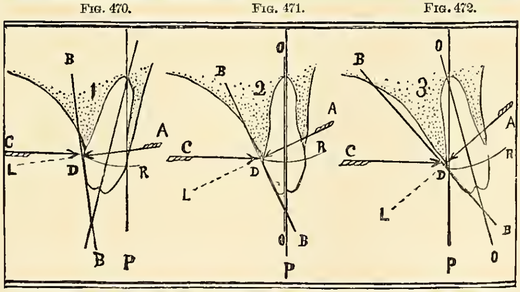


FIG. 473. FIG. 474. FIG. 475.

FIGS. 467-475.—Diagrams showing that the degree of Firmness of Devices relying upon Impingement alone depends upon the Shape as well as the Position of the Teeth.

pends much upon the position of the teeth in the alveolar ridge, it will be seen from an examination of these nine figures that it depends as much upon the shapes of crowns and necks, for this determines the inclination of the surface-plane, B B.

The bell-shaped crowns shown in Figs. 467–469 are the most advantageous to the dentist, and the tapering shapes seen in Figs. 473–475 are least so. Those of the nearly cylindrical shape, as in Figs. 470–472, present a medium between the two extremes. Thus it will be seen that these unfavorable conditions of position existing either before or during the process of widening the arch, and also the shape, present difficulties which render it necessary to employ additional aids to fasten the mechanism to the teeth in a manner that affords security against their falling from position. What these auxiliaries are, and their relative value, has been explained in Part VI.

PART X.

Eruption of Teeth.

CHAPTER XLV.

NAMES OF TEETH.

TIME AND ORDER OF THEIR APPEARANCE.

IN the adult human jaw there are sixteen teeth, classified according to their shape or their use, and known by names derived from Latin roots, as follows: Cuspid, from *cuspis,* a sharp end, a point; bicuspid, from *bis*, two, and *cuspis,* a point; and *multicuspidati,* many-pointed. The more common name for the latter, however, is molar, from *mola,* a mill, having the power to grind, grinding. To distinguish from each other, teeth that are of the same form, with the exception of the cuspids, adjectives are used, thus: central and lateral incisors; first bicuspids; second bicuspids; first molars; second molars; third molars, denominated by ancient authors *dens sapientiæ,* from the Latin *dens,* a tooth, and *sapientiæ,* wisdom, wisdom's tooth.

To abbreviate, the incisors are sometimes collectively denominated front teeth, and the bicuspids and molars side teeth. The cuspids are regarded as corner teeth, but they belong to the former. For further abbreviation, the incisors are often called centrals and laterals.

Time and Order of the Eruption of deciduous Teeth.[1]—The time and order of the breaking of the crowns of teeth through the gum, generally called eruption, varies in different people, therefore only an approximate rule can be given.

Figs. 476, 477, illustrate the jaws of a child at the age of

[1] Revised from a diagram for popular information, designed by the author, and published by S. S. White in 1873.

six years; the deciduous teeth (1, 2, 3, 4, 5) being indicated as anterior to the dotted line and the first adult molar (6), called "permanent," posterior to it. Without discussing the

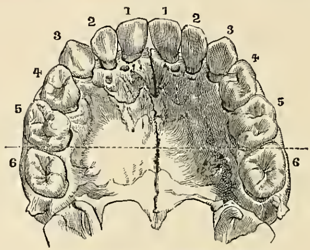


FIG. 476.—Upper Jaw at age of six years.

question as to which set strictly belongs[1] the so-called "sixth year molar," the deciduous teeth may be said to be in pairs, twenty in number, ten in each jaw, five on each side.

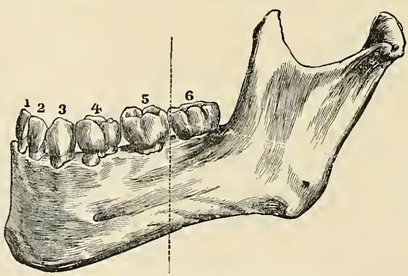


FIG. 477.—Lower Jaw at age of six years.

They usually appear in the following order, the lower preceding the upper by a few weeks:

Central Incisors		1, 1,	from	5th	to	8th month.
Lateral	"	2, 2,	"	7th	"	10th "
Cuspids		3, 3,	"	12th	"	16th "
Molars		4, 4, 5, 5,	"	14th	"	36th "

[1] Dr. Wortman says, "The first true molar in the human dentition is a persistent milk molar." "American System of Dentistry," Vol. I., p. 500.

Two sets of Teeth in Childhood at the same Time.—In infancy the jaws contain the rudimentary crowns of two sets of teeth; the deciduous and the second set. Although in childhood the deciduous set may be fully developed and beautifully arranged, their successors are apparently jumbled together in such disorder that it seems wonderful that they ever appear with any degree of regularity. But underlying the apparent confusion, there appears to be an influence that directs each tooth into its proper place, provided there exist no abnormal counteracting influence. An idea of the appearance of the teeth at this age may be obtained by the examination of Fig. 478.

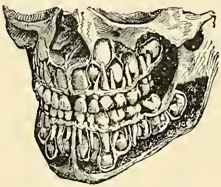


Fig. 478.—Illustrating the Arrangement of the Teeth in the Jaws of a Child of about six and a half years of age.

As the histological details concerning the development of the teeth more strictly belong to works on microscopy and minute anatomy than to the province of this work, I shall not dwell upon them further than is necessary to the understanding of the subject of regulation of the teeth.

It may be said that children usually require the services of the regulator of teeth when about six years of age. At this age the child's alveolus appears packed with teeth. As shown in Fig. 478, the first molars of the second set have taken their places in the rear of the deciduous or first set, but their roots are only about half developed; the upper centrals of the second set lie just under the base of the nose, and above and somewhat inclined anterior to the roots of the deciduous centrals. At this time little more than the crowns are developed. The laterals, which are not so far advanced in their growth, and consist of crowns only, rest behind the roots of their predecessors and beneath the alæ of the nose. The cuspids are situated higher, and above the crowns of the laterals and first bicuspids, but considerably below the (ocular) orbits.

In the upper jaw, the crowns of the bicuspids are situated parallel to the laterals, and are apparently embraced by the roots of the deciduous molars. The crowns of the second molars of the second set, which are only partially developed, are situated in the rear of the partially developed roots of the first molars. The third molars are still less advanced in development, and are situated on a higher plane far back in the tuberosities.

The crowns of the lower centrals of the second set, having only about one-fourth of their roots developed, are behind the roots of their predecessors; and the crowns of the laterals, which are not so far advanced in development, lie partially behind the crowns of the deciduous laterals and cuspids. The crowns of the latter lie on a lower plane, and their partially developed roots extend near the lower plate of the jawbone. The bicuspids are developed to about the same degree as the laterals, and lie on nearly the same plane. The crowns and partially developed roots of the first molars of the second set stand in the rear of the deciduous molars, and the partially developed crowns of the second molars, which are inclined forward, rest on a somewhat higher plane than the bicuspids; while the crowns of the lower third molars, at this time only slightly developed, are hidden under the base of the coronoid processes.

Time and Order of Eruption of the Second Set of Teeth.—The jaws of an adult are shown in Figs. 479 and 480.

The adult teeth are in pairs, and are thirty-two in number; sixteen in each jaw, eight on each side, including

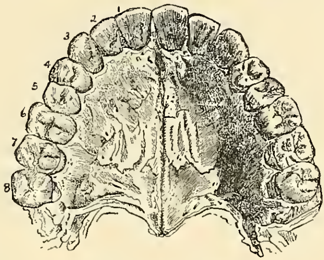


FIG. 479.—Upper Jaw of an Adult.

twelve that never have deciduous predecessors. These usually appear in the following order:

Central Incisors,	1,	from	6th	to	8th	year.
Lateral Incisors,	2,	"	7th	"	9th	"
Lower Cuspids,	3,	"	8th	"	10th	"
Upper Cuspids,	3,	"	11th	"	12th	"
First Bicuspids,	4,	"	9th	"	10th	"
Second Bicuspids,	5,	"	10th	"	11th	"
First Molars, "Permanent," or "6thyearMolar":	6,	"	5th	"	6th	"
Second Molars,	7,	"	12th	"	14th	"
Third Molars	8,	"	17th	"	25th	" (sometimes as late as the 60th year.)

It will be noticed that the appearance of the lower cuspids usually precedes, and that of the upper cuspids follows, the eruption of the first bicuspids.

Probably no teeth are so interesting to the biologist as the cuspids, for, as Owen remarks, "Their true canine character is indicated by the conical form of the crown, which terminates in an obtuse point, is convex outward, and flat or subconcave on the inner surface, at the base of which there is a small prominence." "The conical form," says the same writer, "is best expressed in the Melanian races, especially the Australian. The canine is more deeply implanted, and by a stronger root than the incisors." That these teeth are no longer needed for the tearing of flesh, and are undergoing evolutionary changes, requires no argument to prove; but, that these changes in the cuspids are tending to a rudimentary condition, as has been conjectured, appears to me doubtful. On the contrary, like the human face, they are becoming more beautiful through the influence of civilization, and, as with the face, this enhancement of beauty by evolution does not necessarily prove degeneration.

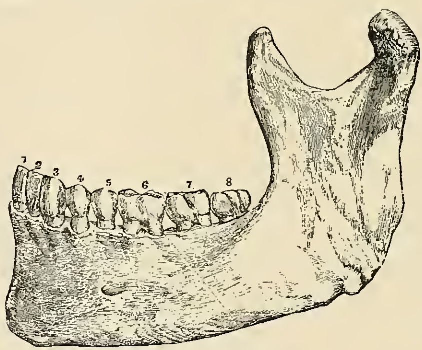


FIG. 480.—Lower Jaw of an Adult.

The causes of irregularity in eruption have been treated in a previous Part (Etiology), but briefly they may be said to be: 1st, prenatal malposition, or malformation of the bones; 2d, accident; 3d, neglect or unwise judgment, either in being too hasty or too tardy in the matter of extraction of some of the deciduous teeth, or possibly some of the second set. The treatment of cases belonging to these various phases begins in Part XIV., Extraction.

PART XI

Antagonism of Teeth.

CHAPTER XLVI.

ANTAGONISM OF THE TEETH, THEORETICAL AND ACTUAL.

DIFFERENT LINES OF OCCLUSION.

THE upper teeth are arranged normally upon a somewhat larger arch than the lower; the incisors and cuspids overhanging in front, whilst the outer cusps of the bicuspids and molars rest in the outer recesses made by the curvature of two lower adjacent teeth, and partially against the proximate surfaces. A knowledge of what constitutes normal antagonism is one of the most important requisites to the successful practice of dentistry; not only is it necessary in order to arrange artificial substitutes, but to improve antagonism for the purpose of maintaining health in those in whom it is liable to be impaired through insufficient mastication of food.

The best arrangement of the teeth for antagonism permits each upper tooth to extend over portions of two of the lower teeth, thus enabling all the teeth to withstand greater force in mastication than would be possible if each tooth had its individual antagoniser. The third upper molar is an exception.

Fig. 481 is a diagram illustrating approximately the relation of the teeth as they would appear if the arch could be brought into a straight line.

For explanation, beginning at the median line, and confining ourselves to one side, this arrangement in detail is as follows: The upper central, being broader than the corresponding member below, covers the lower central fully, and about half of the width of the adjacent lateral; the upper lateral covering the remainder of the lower lateral, and about half the cuspid beside it. The other half of the lower cuspid is covered by the upper cuspid, which also extends beyond and over the anterior half of the first lower bicuspid. The posterior half of this first lower bicuspid and the anterior half of the second lower bicuspid are covered by the first upper bicuspid. In a similar manner, the second upper bicuspid covers the posterior half of the second lower bicuspid, and the anterior third of the first lower molar,

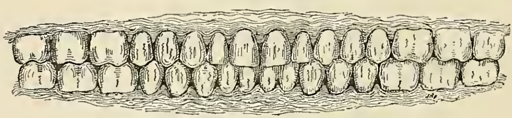


Fig. 481.—External View of Antagonism.

leaving the posterior two-thirds of this lower molar and the anterior one-third of the second lower molar to be covered by the first upper molar; while the remainder of the lower third molar is covered by the upper and somewhat smaller third molar.

In other words, the upper central being broader than the lower central entirely covers the latter and half of the adjacent (lower) incisor, the upper lateral covers the remaining half of this lower lateral and half of its neighbor the (lower) cuspid; the upper cuspid covers the remaining half of the lower cuspid and half of the adjacent (lower) first bicuspid; the upper first bicuspid covers the remaining half of the lower first bicuspid and half of the adjacent second (lower) bicuspid; the upper second bicuspid covers the remaining half of the lower second bicuspid and the anterior third of the first (lower) molar; the upper first molar covers the remaining two-thirds of the lower first molar and one-third of the second (lower) molar; the upper second molar covers the posterior two-thirds of the lower second molar, and one-third of the third lower molar, while the upper third molar (somewhat smaller than its neighbors) covers the remaining two-thirds of the lower third molar.

What constitutes a proper arrangement of the teeth depends in some degree upon the facial outlines, but some idea of the average normal arrangement may be obtained from the following figure (482), which illustrates the teeth of a young Paraguayan of unmixed blood. This is drawn from a model made by Dr. E. M. Flagg.

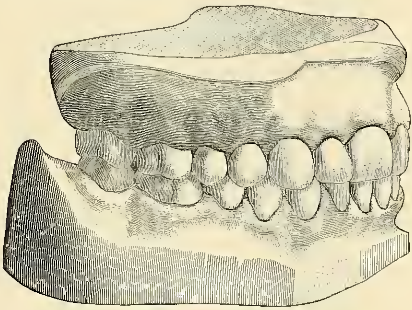


Fig. 482.—Natural Antagonism; Teeth of a Paraguayan.

Dr. Flagg says[1] that this man had all the characteristics of a South American Indian, and from what information he could gather had lived "according to nature." This model is regarded as a superior specimen, as it has none of the points of imperfection which characterize the teeth of the average North American. It will be noticed also that the third molars, if there were to be any, had not yet appeared.

[1] "Dental Cosmos," Oct., 1886.

Antagonism theoretically considered.—Fig. 483 theoretically illustrates the teeth of the upper jaw, showing by the dark shading the relative position of the antagonizing surfaces. In nature, however, this is not truthful, because of interfering points caused by the irregularity of the surfaces

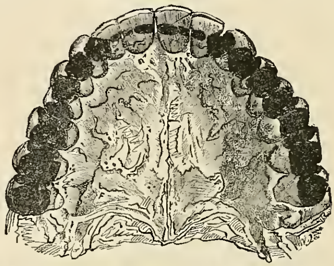


FIG. 483.—Theoretical Illustration of Antagonizing Surfaces.

of the teeth. This defect is partially overcome in time by the wearing down of these points, thus permitting the other portions of the teeth to come in contact. Owing to this circumstance, people who save their teeth sometimes find that they can masticate their food better in middle life than in youth. Theoretically, by the lower dental arch closing upon the upper, it moves posteriorly by the cusps of

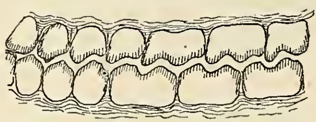


FIG. 484.—Theoretical Antagonism.

the lower teeth sliding upon those of the upper, until all the apices rest in the corresponding sulci, when the antagonism is perfected all along the irregular line, as shown in Fig. 484, but in nature no such perfection of antagonism is found.

Normal Antagonism.—To ascertain the actual antagonism in any given case, take a sheet of bees-wax, say less than one-eighth of an inch in thickness, warm it to such a degree as to be flexible, then instruct the patient to bring the teeth together upon it. When this is done, hold the wax between the eye and the light. Wherever there is antago-

FIG. 485.—Appearance of a Sheet of Beeswax showing actual Contact of the Teeth as found in Nature. Case 1st.

FIG. 486.—Actual Contact as shown in a sheet of Wax (upper impression). Case 2d.

nism, there will be little or no wax left, see Fig. 485. The sheet will also show by the indentations to what degree the remaining points approach each other, as the antagonizing ends of the teeth will leave their impression in full size. (See Figs. 488–489.) Figs. 486–487 represent similar impressions.

These illustrations are engraved from actual bites in sheets of wax. It is easier to imagine than describe how imperfect is the average antagonism, since these illustra-

FIG. 487.—Actual Contact of Teeth, taken in Wax (upper impression). Case 3d.

tions represent superior specimens; and as antagonism is necessary to the proper mastication of all uncomminuted food, does not this explain in many cases the cause of dyspepsia among people who have not average antagonism?

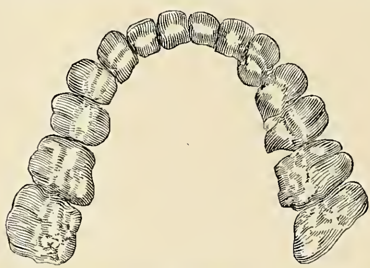


FIG. 488.—General Appearance of the Lower Surface of a Sheet of Wax bitten upon by Case 2d.

Figs. 488 and 489 represent the general appearance of the same sheets of wax, which are about an eighth of an inch thick. Though showing their inadequacy for the mastication of meat, it is a sufficient approach for mastication of cereal foods.

Lines of Antagonism.—The normal line of the dental arches may be on the same plane or straight, or it may be on an uneven plane or curved; sometimes this curve is single, like a bow, as shown in B, Fig. 490, sometimes double, re-

Fig. 489.—General Appearance of the Lower Sides of a Sheet of Wax after being bitten upon by Case 3d.

sembling the letter ∽ turned downward anteriorly, D, and upward posteriorly, C, as in Fig. 491. To decide which of these lines is in the highest degree esthetic, can only be done

Fig. 490.—Single curved Line of Antagonism.

Fig. 491.—Double curved Line of Antagonism.

in connection with study of the facial conformation. But judging from the examination of the teeth of many patients, and the study of many jaws belonging to well-shaped skulls,

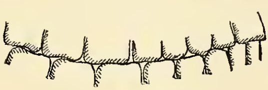


Fig. 492.—Single Curve.

I find that the line of antagonism is generally curved downward along the middle section of the side teeth, lowest at the first and second molars. Fig. 492 illustrates this curve in an extreme degree. When the line has a double curve, the upper incisors generally project over in front of the lower incisors considerably more than when the line of antagonism has but one curve, (shown by Fig. 493).

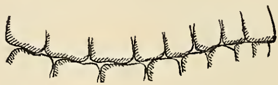


Fig. 493.—Double Curve.

This curvature not only makes possible the cutting off of food, but also by the inclination of the inner walls of the incisors and cuspids, aids in directing the lower jaw to its proper place in grinding, and renders the power of antagonism more effective. The principal grinding agency in antagonism, after the lower jaw has once started back, lies in the form of the cusps of the side teeth; this, together with the inclined surfaces of the anterior teeth, constitutes theoretically a matrix all around.[1]

This line of antagonism, in connection with the cusps, permits the cutting of the food with the anterior teeth and its mastication with the side teeth to be carried on separately, without interference. For instance, in the act of biting off a piece of food, the lower jaw is carried forward sufficiently to bring the lower anterior teeth directly under the upper anterior teeth. By this contact of these teeth, when their long axes are made to correspond, the side portions of the arches part so that these teeth do not interfere with each other; but, as soon as the food is cut off, the lower jaw falls back, the ends of the lower incisors and cusps sliding upon the inclined lingual surfaces of those of the upper, until the inclined surfaces of the cusps of the side teeth are brought in contact, and then all the teeth glide into their

[1] The first effort to draw attention to this curvature is accredited to Dr. Davenport, of Paris.

proper locks. The normal arrangement of these cusps is such that the outer row of the lower teeth fits between the two rows of the upper teeth; and the lingual row of the upper rests in the irregular line of sulci between the two lines of cusps of the lower teeth. When the teeth are arranged so that the antagonism is most effectual, the cusps and sulci permit the teeth to act freely, with but slight separation of the jaws. This arrangement does not prevent the full use of the antagonizing surfaces of these teeth, still the area of actual contact of the two dental arches is not so great as it would theoretically appear.

The division of the dental arch into sections, constituting what are denominated teeth, together with the peridental pocket (cushion), in which each of them rests, allows greater elasticity of movement than would be the case if all the teeth were massed into one. This independence of action not only renders them less liable to wear away, but also enables them to move about by the antagonism of their inclined surfaces until they fit themselves to each other. If one section becomes disabled, so that it is necessary to extract it, the remainder are held comparatively undisturbed. The theory of this independent movement of the teeth in most cases is proven by the worn and highly polished facets that are plainly noticeable on the approximate surfaces of teeth in aboriginal skulls, which can be seen in museums.

In the art of correcting irregularities, a perfect understanding of antagonism, and of the influence of lateral pressure of adjacent teeth, is still more important to insure the permanence of the new relations after correction; for it should be remembered that success in regulating teeth depends not only upon adjusting them so that they will have sufficient room to stand freely, but also upon holding them in place by the interlocking of some of the cusps. Indeed, without this knowledge, no one should expect permanent success in his operations. In some cases, it is even more difficult to fix the teeth so that they will remain in their new positions than it is to move them into line.

Teeth that are in their normal positions in the depths of the jaw during the early stages of their development, generally erupt in proper order or nearly so ; but, whether their appearance be regular or irregular, the permanence of their after position depends as much upon their antagonism as upon the lateral support. For, although irregular teeth may tend in a measure to assume a correct position, if liberated, the interlocking of the cusps in antagonism often prevents them from doing so. It is evident that if teeth erupt in an irregular position and are locked there, so that the deformity is permanently fixed, then, on the same principle, regulated teeth may be retained permanently in their places by proper locking of the cusps.

There are, however, some aspects of this question that should be observed ; for instance, if the line of continuity of the arch is broken by the loss of some of the teeth, and some of the remaining teeth antagonize obliquely, a greater or less number, adjacent to the gap, will probably move away from their neighbors along the open territory ; or, if the obliquity is in the opposite direction, toward a portion of the mouth which is already overcrowded, not only may the deformity become more striking, but, at the points of contact, necrosis of the enamel may occur. In such cases, the enamel in time breaks down in decay. Thus it will be seen that the locking of teeth has its advantages as well as disadvantages.

Perfection not attainable.—Perfect antagonism, such as is found in the highest order of human development, is a condition that cannot be attained in all cases, but must be regarded rather as a point to be aimed at and reached so far as practicable. An attempt to secure more would not only be found impracticable in many cases, but (if possible) it might also be at the sacrifice of esthetic results. To reiterate, although, theoretically, perfection of antagonism is desirable, it is in practice not only often impossible to attain, but in some cases it would also be injudicious to attempt it, as it might increase facial deformity.

In cases where the upper alveolar ridge is too small to accommodate the teeth, which are consequently overcrowded and jumbled, while at the same time the jaw and upper part of the face correspond in size with the lower, it is evident that if we proceed to enlarge the upper arch sufficiently to accommodate all the teeth in line, we would not only destroy the antagonism, but would also cause, as has been implied, protrusion of the lips. To avoid this result, extraction of one or more teeth is the only alternative, in order to bring about the arrangement which best combines usefulness with improvement of the face. In some cases, antagonism should be regarded as second in importance. That is to say, the aim of the operator should be to reach the highest possibilities, taking all things into consideration. To avoid deforming the face, while securing the best antagonism possible under the circumstances, is more desirable than to gain antagonism by the sacrifice of appearance. Let us try to increase usefulness by improving antagonism and mastication as far as possible, but let us not, in order to effect these, permit the faces of our patients to assume the appearance of apes.[1]

[1] There is a phase of the subject of antagonism that embraces the hypothesis that certain teeth serve as buttresses and keys in maintaining the dental arch; concerning this question see Part XX. Vol. 2.

CHAPTER XLVII.

ANTAGONISM GEOMETRICALLY CONSIDERED.

OCCLUSION OF JAWS.—OBLIQUE ANTAGONISM.

THE art of moving teeth lies in the proper application of force to their surfaces. It is not, however, necessary in all cases that the force should be directly behind and on

FIG. 494.—Section View, showing the Malposition of the Incisor Teeth caused by diagonal pressure occasioned by loss of the Side Teeth.

the line of the desired course of the teeth; for teeth often move by a force diagonally applied, as in the case when a device called the "inclined plane" is used. But diagonal pressure is well known to be a possible cause of irregularity at any period of life. This is strikingly shown in advanced age, when, the molars and bicuspids being lost, the work of mastication falls on the front teeth, forcing them forward, and causing the lips to protrude. See Fig. 494.

Fig. 495[1] geometrically illustrates the successive changes brought about by diagonal antagonism of central incisors, occurring after the loss of the grinding teeth.

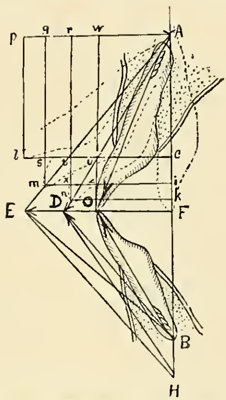


Fig. 495.—Section View of Incisors, illustrating the philosophy of Changes in the Position.

To examine into the philosophy of this diagonal action, reference is made to the figure, which represents, by plain and dotted lines, the various positions. Through the apices of the roots of these teeth, let fall a straight line, A H. At right angles to this line, at the point F, project the line F E, passing between the antagonizing edges of the teeth at the point O. Draw other lines from the apical points, as A O, A D, A E, B O, B D, B E; also, parallel to A F, the lines *l p*, *m q*, *n r*, O *w*. Parallel to the line F E, draw others from the cutting edge of the dotted representations of the upper teeth.

[1] Published in "Dental Cosmos," May, 1881 (A).

Since the lines, O w, n r, m q, and l p, are parallel to A F, and c l, i m and k n are parallel to F E, then A w and F O are equal, as are also A r and k n; A q and i m; also A p and c l. It will now be seen that if the antagonizing edges of the teeth should meet at the point F, on the line A H, there would be no leverage, and hence they would not be liable to be forced out of position. But, should they meet at any point outside of this perpendicular line, then these teeth would act as levers upon the sockets, and the often-repeated force from occlusion would tend to cause each to advance its cutting edge toward the point E; and as A r is greater than A w, and A q and A p are greater than A r, it will be seen that the leverage correspondingly increases, as the cutting edges successively attain the positions shown by dotted lines at the points n m l, and will cause a corresponding increase in the rate of outward movement of the teeth.

Occlusion of Jaws. — While mischief may arise from improper antagonism, that which occasions it may, in the hands of a skillful operator, be turned to good account in correcting irregularities. Single teeth, by a little grinding or reshaping of the antagonizing surfaces, may be made to take proper positions, and even large portions of the arch may occasionally be moved by so reshaping the teeth that they will antagonize as if on inclined planes.

All the space necessary for overcrowded teeth to stand free in, may sometimes be brought about by grinding the cusps, and so shaping the antagonizing surfaces as to remove the "lock" in the antagonism. This done, the adjacent teeth will occasionally assume correct positions without the aid of mechanical devices. An important suggestion may be taken from the foregoing with regard to retaining teeth in position after correction, as they may be shaped with a corundum-wheel, or by inserting suitably shaped excess-fillings thus causing proper antagonism.

Fig. 496 is an illustration of such a procedure based on the principle explained in the preceding figure. The grinding surfaces of two antagonizing bicuspid teeth are ground at such an angle as to cause the point of contact to be as far outside of the perpendicular line, A, B, as possible, causing the teeth, when brought together, to act as levers upon the

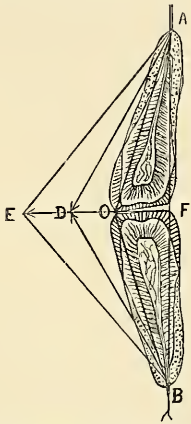


FIG. 496.—Illustrating the philosophy of moving the Teeth by Antagonism.

socket-walls; a tendency is thus given to the teeth to force themselves along the line, F, E, in the direction of D and E. It will also be seen from this diagram that, if practicable, such an arrangement may be used in retaining several teeth, or even a large portion of the arch after it has been widened. Although these conditions sometimes exist, they are not sufficiently common to furnish precise rules for practice. For other features of applied force the reader is referred to Part IX.

Oblique Antagonism.—While antagonism is beneficial in retaining teeth in place, and even in causing a desired movement toward correction, it is often a source of mischief in causing irregularity, which might be avoided by a little skillful reshaping of the teeth by grinding away interfering points. This influence makes itself manifest in various ways by the pushing of individual teeth out of line and sometimes by pushing large sections out of place, as in cases to which we have referred of the lower front teeth of aged people who have lost the side teeth. Occasionally entire arches antagonize so obliquely as to cause their enlargement.

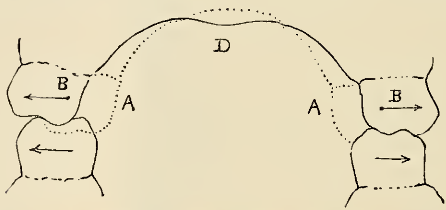


Fig. 497.—Illustrating the effect of Bearing outside of the Fulcrum.

Case.—Of this latter variety, may be mentioned a case in practice of a lady about thirty years of age, strong, healthy, and apparently having no disease of the socket. Although her teeth have always been in line, both arches have been gradually widening, the teeth separating more and more during several years; the arches are now not only very large, but appear to be in danger of collapse, because of the tendency of the teeth to approach a horizontal position. As I have casts, taken from impressions made from year to year, I am able to make accurate comparisons. Fig. 497 illustrates a sectional view of the two jaws, cut between the first and second molars; A, A, dotted lines, illustrate the original position of the upper arch; the arrows show the direction in which the teeth are now moving. There is a wide space between the right upper lateral and cuspid.

The latter tooth is abnormal in shape. There is also a space in the corresponding place of the opposite side, but wider, because the left cuspid has never appeared. If the cuspid were present, there would still be a gap on this side as on the opposite, one-eighth of an inch wide. Having drilled the alveolar process here and there, in search of an adult cuspid, and failing to discover any trace of one, an artificial tooth was inserted on a plate, but it soon became useless because of the continual widening of the arch. This effect upon the use of the plate was what first led me to study the cause of the widening, and I was enabled to ascertain the exact rate of destruction. Whether the opening of the median suture is an important factor in this case, is difficult to determine; but that this has occurred to some extent is evident by the separation of the centrals and a prominence in the palatal surface, which may have been caused by the falling of the sutural borders, consequent on the moving outward of the two sides of the alveolar ridge. A strong skeleton frame might be placed so as to bind around the outside of the arch and hold the teeth in place; but this the patient will not permit, because of the unsightly appearance when the teeth and gums are exposed.

Method of Examining the Antagonism.—The objects

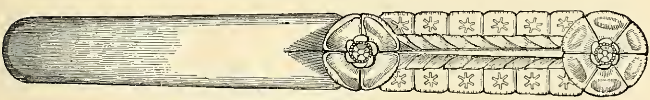


FIG. 498.—A flat Cheek-distender for examining Antagonism.

aimed at being clearly understood, it will be seen that one of the first things to do is to ascertain the condition of antagonism. As an aid in accomplishing this, curved cheek-distenders, such, for instance, as illustrated (Figs. 498–9), are desirable. With the aid of such instruments every tooth can be seen, but to obtain a correct judgment, an impression of the patient's teeth in a sheet of wax, as before explained, is necessary.

We have now arrived at the actual operations for the correction of malposed teeth. Pre-supposing that the reader is now somewhat versed in the history of mechanisms, I think it is not necessary to go minutely into the subject.

As long ago as the days of Fauchard (1746) and Bourdet (1786), Fox (1803), Delabarre (1830), and Harris (1850), several devices for their correction were described and the operations explained. Fauchard and Bourdet, who appear to have been the first to give attention to the mechanics of this branch of dentistry, invented a few mechanisms, but they were so clumsy and inconvenient that they were seldom adopted. Fox and Harris seem to have taken the lead in giving practical directions based on philosophical principles. The instruments recommended by these writers consisted of traction strings tied from tooth to tooth, narrow bands, the extremities of which were anchored by strings, and by metallic thimble-crowns covering some of the posterior teeth; different forms of inclined planes and "gag-things," to hold the jaws apart. Fox described the chin harness for drawing back the protruded lower jaw. Of the various methods based on these principles and of others, which have superseded them, full details will be found in Vol. 2. The remainder of this volume will be principally devoted to other phases of the science and art.

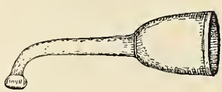


FIG. 499.—Thimble-finger. (Taft.)

PART XII.

Correction of Teeth by Grinding.

CHAPTER XLVIII.

APPARENT CORRECTION OF IRREGULARITIES OF THE TEETH BY RE-SHAPING THEM.

GENERAL AND SPECIAL REMARKS.—HOW TO AVOID CAUSING PAIN IN GRINDING.

A VERY interesting phase of improvement in the appearance of teeth will now be considered. It has for its object the apparent correction of irregularities of teeth without moving them, and consists in improving the appearance by reshaping such teeth as are ill-shaped, or turned or slightly inclined out of position. In the latter case, the crowns often overlap each other, while at the same time the apices of the roots may not be far, if at all, out of place. This method of treatment I have practised to a limited extent from 1864, and quite extensively since 1873, with great satisfaction to my patients and myself.

FIG. 500.—Conditions of Teeth improvable by Grinding.

Figs. 500–501 illustrate the conditions of irregularities that are amenable to this treatment.

The shortening of teeth that have grown longer than those adjacent to them is an old operation; and the cutting away of decayed portions of teeth that overlap, before filling the cavities, is not new; nor is the idea of otherwise reshaping the teeth for esthetic ends modern, for we read that it was practised in the East, centuries ago. Berdmore, who wrote in 1748, says that "filing teeth into order" was a common practice in his time. Fauchard (1746) also speaks of its being a valuable method of remedying certain defects. Although more frequently practised of late than formerly, it has not grown into favor, because of prejudice and ignorance of people as to the true character of enamel tissue. To have published, much less advocated these operations at an earlier date than in the present decade, would have probably been regarded as such a heresy that much opposition would have been excited. Even in a paper on Regulation, which I published several years ago, I thought

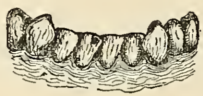


Fig. 501.—Conditions of Teeth Improvable by Grinding.

it prudent only to hint at grinding teeth as an esthetic measure. It is with some hesitation, and a sense of responsibility, even now, that I publish my views and plans of practice in improving the appearance of teeth by this method, not because of the adverse criticisms of those who believe that a tooth, under any circumstances, should not be filed, ground, or otherwise made to assume a shape different from that which nature and natural wear have given it, but because it is possible that careless and inartistic operators, or those whose knowledge of dental anatomy is insufficient, may, through lack of judgment or taste, inflict injury instead of conferring a benefit.[1] Judging,

[1] Since these chapters upon grinding were written, a short but creditable paper upon the same subject by Dr. Howe has been published in the "Dental Cosmos," December, 1886.

however, from many years of experience upon thousands of teeth, in which I am led to think that no patients have been dissatisfied with results, and encouraged by hundreds who have been delighted with them, I feel it now a duty publicly to explain what seems to me to be one of the most beneficial operations for the improvement of facial expression that comes within the province of dentistry.

The second objection, that correction of deformities is an interference with nature, is absurd, for, carried out to logical conclusions, it would forbid all attempts at removing deformity. On this ground, hare-lip, crooked limbs, every natural defect, should be neglected. All operations in dentistry, except possibly extraction, would be barred by this rule. Nature abounds in abnormalities that can be corrected; and the argument that man has no right to correct them is as unsound as would be a notion that cookery is an interference with the laws that govern digestion. Overlapping teeth, as well as improperly shaped ones, are as surely deformities as club feet, and may with the same propriety be treated for improvement. It is evident, however, that objections of this kind belong rather to a past age than the present, for the century is rich in arts and devices whose object is, not so much to improve on nature, as to give nature the opportunity to appear at her best.

As before said, some authorities are opposed to grinding the approximal surfaces of a tooth to correct irregularities, but this objection, I think, should be qualified. To grind a deciduous tooth with a disc to make room when only a small space is required, is a practice that I know from experience is often better than to extract the tooth. Even the slight grinding of a fully developed adult tooth, such as the "cheek prominence" on the approximal side of a cuspid, may possibly be allowable under rare circumstances even in childhood, but the ruthless destruction of tooth tissue, exposing the dentine by making wide V-shaped spaces, cannot be regarded as justifiable at any age.

Special Remarks.—In order that the reader may better understand this subject, diagrammatical illustrations will be introduced to explain the optical effect of grinding at different points. These operations will be denominated as shortening, bevelling, and "trueing-up."

Fig. 502 illustrates by three views the appearance of a too long incisor before and after the shortening process. R and R′ show two views before being ground off to the line of the arrows, while R″ shows the appearance of the tooth after the operation.

Fig. 503 illustrates two lower incisors overlapping, as they appear before the trueing-up operation, the arrow

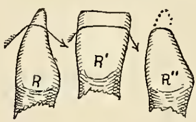


Fig. 502.—Shortening.

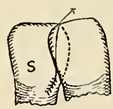


Fig. 503.—Trueing up.

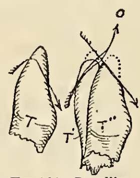


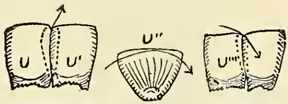
Fig. 504.—Bevelling.

representing the surface line after the operation upon the outstanding tooth. The same operation may be supposed to have been performed to some degree upon the instanding lap (indicated by a dotted line) of the other tooth.

Fig. 504 illustrates in T an inwardly inclining lower incisor, as it appeared before grinding it to the line of the arrow. T″ illustrates the same tooth standing alongside of another, T′, showing by contrast the inclination. These also show by dotted lines the top portions ground away, while the arrow O illustrates the line of bevel made on the labial side of the outermost tooth, T′, and the arrow on the other tooth, T″, the same on its lingual side. The value of this operation will become more apparent as we proceed.

Figs. 505–7 illustrate the method of causing optical illusion by making a bifurcation-notch in the top of one tooth, U, and by trueing-up of the side of its mate, U′.

In proceeding to operate, the first step is to true-up the side of the overlapping tooth, U′; the second, to bevel the same tooth as in U″, to make it lose some of its prominences; and the last is to bifurcate the inner lapping tooth U‴, by grinding a small notch at the top, near the point of



FIGS. 505, 506, 507.—Trueing-up and Notching.

mergence of the arrow, Fig. 505. To leave the instanding tooth lapping upon the posterior side of its mate without making this notch would leave the irregularity still noticeable. The appearance of six lower anterior teeth in such

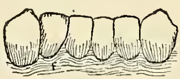


FIG. 508.—Appearance of a Case of Lower Front Teeth after the "Trueing up" and Notching processes.

a case, after having been reshaped, is illustrated in Fig. 508. As more will be said on this subject later we will now confine our attention to other phases.

In grinding teeth judgment should be exercised, for while the tooth may be ground to a certain extent without the least injury resulting, and without causing much, if any, subsequent sensitiveness, a great deal of annoyance can be caused and may exist for a considerable time, if the grinding is carried to excess. The extent to which teeth may be painlessly ground differs in different people, and even in different teeth in the same person. But this operation, even in the extreme, is infinitely less injurious to the patient than the wholesale destruction of the crowns of sound teeth practised by some dentists for the purpose of making a foundation for what is called "bridge work."

Pits and Grooves.—Besides shortening, trueing-up, bevelling and notching teeth, for the apparent correction of irregularity of position, the art of beautifying teeth by grinding includes, so far as the process can be carried with-

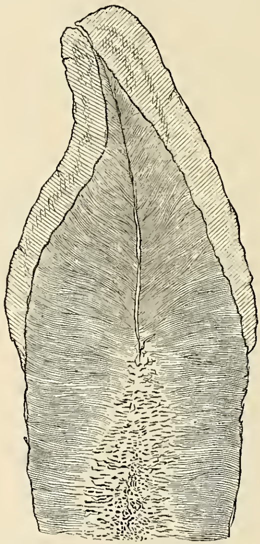


FIG. 509.—Uneven Enamel. (Cosmos.)

out injury, the removal of any roughness of the enamel, and the obliteration of small pits and shallow grooves on the labial and buccal surfaces, in order to prevent collection of foreign matter, which sometimes lodges so firmly that the bristles of the tooth-brush, by springing across the pit, fail to dislodge the *débris*, thus causing by contrast with the highly polished surrounding enamel an unsightly disfigurement (see Fig. 509).

To shape a tooth so that every point of the external surface can be swept clean by the brush, shallow pits and hollows should be obliterated by grinding the surrounding surface even with the plane of the pits, or the pits should be enlarged to a broad hollow so that the bristles can sweep along the bottom; but these hollows should be so shaped that the bristles will not be guided into them and wear them deeper. Deep pits should be plugged.

In cases where the enamel is very thin in places and imperfectly developed generally, the cutting ends of the teeth ragged and dwarfed from arrest of development in their earlier stages, or when the edges are like the teeth of a saw, the defects may be materially lessened, if not obliterated, and the teeth rendered much more durable by the process. Indeed, the improvement that can be made in such cases can only be fully appreciated by seeing it.

How to avoid causing Pain in Grinding.—A sufficient shortening by grinding cannot always be brought about at a single operation on account of causing sensitiveness. Before arriving at the point of pain, there are premonitions indicated by the patient that should deter the operator from proceeding further. Sensitiveness arising from heat or from the electricity generated by rapid and long-continued grinding should, however, not be mistaken for pain caused by an approach to sensitive dentine.

It may be profitable to give here a few hints, concerning the matter of pain, as it may be brought forward as an argument against the process. It is my custom at subsequent visits of patients who have recently had their teeth ground to inquire as to whether any unpleasant sensations have resulted from the grinding. Not long ago, a gentleman, who had had his teeth ground with very satisfactory results, sent a patient to me for the same purpose. A few days after the operation, which made a great improvement in her appearance, I asked the gentleman who referred the patient to me whether the grinding of the lady's teeth had caused sensitiveness. He said, "Yes, she has had a great deal of trouble from it." On the following day the lady personally called, and I asked her the same question. She promptly replied, "No, nothing more than a queer sensation while drinking cold water, but even that quickly passes away, and its recurrence is becoming less and less noticeable. I am delighted with the improvement."

Another case was that of a very young lady, who had had her teeth ground. After several months, upon inquiring of a friend of hers about the condition of the teeth, I was told that they had been made very sensitive. I doubted the statement, and on investigating the matter, I found that the complaint had no foundation in fact; but was used by the young lady's father for the purpose of lessening the bill. But, notwithstanding the fact that these reported instances of pain as resulting from grinding were untrue, I must emphasize that the operation should always be performed with intelligent caution; that although within certain limits grinding is safe, beyond these limits it will cause trouble for a longer or shorter time, especially if the patient indulges in drinking ice-water or eating sweets.

Newly ground teeth are apt to be somewhat sensitive to cold air, as well as cold drinks, and for this reason, I would suggest that it may be better to perform the operation in warm weather than in cold. However, I grind teeth at all seasons of the year, but do not carry the operation so far in cold as in warm weather; and in any season I always cease grinding on the first sensation of pain felt by the patient, who is instructed to give me prompt notice of its occurrence.

CHAPTER XLIX.

DETAILS OF THE PROCESS OF BEAUTIFYING TEETH.

SHORTENING TEETH.—IMPROVEMENT BY OPTICAL ILLUSION.—POLISHING TEETH AFTER GRINDING.—WHEELS FOR GRINDING.

THE details of the process of beautifying teeth are as follows: After careful examination of the organs at various angles to decide on the necessary alterations, it is well to inform the patient that the operation of grinding is at first disagreeable, but that the unpleasant sensations gradually become less noticeable; and, that though the action of the wheel causes noise and some heat, there is little actual pain. A hand-mirror, held by the patient, enables him to see the process of improvement, and has an encouraging effect. The operation should not begin with an abrupt and long-continued application of the wheel, but with a few light touches. At intervals of one or two minutes the general process should be further intermitted by periods of rest, say a few seconds, but not long enough for a complete relaxation of the nervous tension of the system. Further suggestions on this subject will be made after describing the instruments used.

Wheels for Grinding.—The wheels should contain sharp corundum dust, (not too coarse,) so as to be able to grind rapidly. If there is too large a proportion of shellac in the wheels, they are worthless. Several wheels are necessary for efficiency, and they should vary in size from one-fourth to one inch in diameter, and from one thirty-second to one-eighth of an inch in thickness. The proper size to use depends, of course, on the requirements of the case.

Fig. 510.—Section views of thin Corundum-wheels.

Fig. 511.—Side and section views of thick Wheels.

To secure firmness and strength in the instrument, wheels should be set on screw and nut mandrels, made so that the collar-nut rests on a shoulder made on the shaft by turning in a lathe, the screw portion of the shaft smaller (as shown in Fig. 512); instead of having the entire shaft of one size, as usually found at the present time in the shops.

Fig. 512.—Nut Mandrel.

This collar-nut should also be soldered in place. The screw-nut should be about one-eighth of an inch in thickness, with all irritating corners rounded off.

Shortening Teeth.—For shortening teeth a wheel from one-sixteenth to one-eighth of an inch thick, and from three-eighths to five-eighths of an inch in diameter, is the most useful size. Wheels of these dimensions are especially suitable for bicuspids and molars, and are also useful for incisors. In cases where the front teeth require considerable shortening, however, it is less tedious to cut them off with a thin corundum wheel than to grind them down from the top with a thick wheel. This cutting is accomplished by first making a groove across the labial surface near the line of desired separation, substantially as shown in Fig. 513, after which the groove may be extended around toward the approximal surface. A groove on the lingual side of the tooth is sometimes practicable.

While the wheel may be held in any position upon the anterior teeth (so far as doing the work is concerned), the noise is least disagreeable if the plane of the wheel is made to correspond with the longer transverse diameter of the

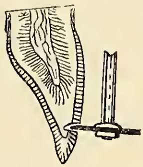


FIG. 513.—Cutting a portion off a Tooth with a Corundum-wheel.

crown of the tooth, and is most noticeable when the plane corresponds with the shorter diameter. In other words, if the plane of the wheel corresponds with the line of the dental arch, as shown in Fig. 514, it is less disagreeable than if it is applied transversely.

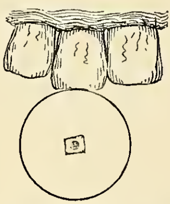


FIG. 514.—Method of applying the Wheel which will cause the Minimum of Inconvenience.

But, while the avoidance of discomfort is desirable, it is not always practicable to do the work well by holding the wheel so that its plane corresponds with the line of the arch. It is right to show consideration for the patient's feelings by operating so carefully as to avoid causing unpleasant sensations as far as possible, but this consideration should not be carried so far as to interfere with the success of the operation, which is, of course, the paramount desire of the patient. When it is necessary to use the wheel transversely with the arch, much of the annoyance from the jar or vibration can be avoided by holding the finger firmly against the tooth which is being ground.

It is not always easy to determine in what cases the grindstone should or should not be used, but there are many instances in which the benefit is so self-evident that there should be no hesitancy—for instance, when one central projects beyond its mate, to such an extent as to be instantly noticeable, causing a palpable disfigurement. Fig. 515 illustrates such a case, and Fig. 516 the same case after the operation of shortening the left central was completed so as to make it even with its mate, and after the ends of the laterals had been ground to resemble each other.

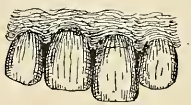
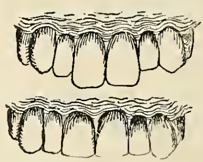


Fig. 515.—Before the Evening Process.

Fig. 516.—After the Evening Operation.

Some further idea of the need of this class of operations may be obtained from Fig. 517, which shows the condition of the teeth in the case of a lady for whom I performed the operation in the earlier part of my professional career, and



Figs. 517, 518.—Appearance of a case Before and After the Operation.

at a time before I had heard of its having been previously done by other dentists. The deformity consisted in the too great length of the upper central incisors, a peculiarity of the family (for several of whom I afterward performed the same kind of operation). The process of correction consists in simply shortening these teeth and "squaring off" the lateral incisors so as to harmonize better with each other. Fig. 518 shows the improvement that was brought about by the operation.

Improvement by optical Illusion.—The degree to which grinding will esthetically improve the upper centrals depends much upon the relative length of the crowns of these teeth and those of the laterals. It is important also to take into account not only the extent to which the ends of the former project beyond the ends of the latter, but the relative position of the gum-border of the crowns, and the habits of the lips as to exposing the gums during conversation or laughter. To achieve the best effects in some of these cases, the operation, as in others before mentioned, should be conducted with a view to creating an optical illusion.

If a line drawn along the necks of the centrals and laterals should prove to be nearly straight, or in every part on

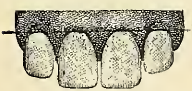


Fig. 519.

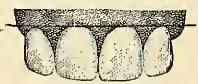


Fig. 520.

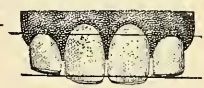


Fig. 521.

Figs. 519-521.—Illustrating the Effect by Optical Illusion.

nearly the same plane, as shown in Fig. 519, whether the patient shows the gums or not, the centrals should not be ground quite as short as the laterals; in other words, the ends of the centrals should not be made even with the ends of the laterals, but should project a short distance below as shown in Fig. 520.

But if the portion of the crowns of the centrals exposed while laughing extend above the plane of the gum line of the laterals so that the line drawn from one lateral to the other would fall across the face of the centrals, as shown in Fig. 521, and the gums of the patient should show when laughing, then the ends of the centrals may sometimes be advantageously ground even with the laterals, as the effect by the exposure of the portion of the centrals lying above the upper hair line (Fig. 521) will be about the same as in the other case (Fig. 520). This degree of shortening is indicated by the lower hair line. (Fig. 521.) The eye is nearly as well satisfied by the relative proportion in length of these two classes of teeth as if the gum line and the line of the cutting edges were nearly parallel with each other.

FIG. 522.—Appearance of Incisors with Gum Line even and Centrals long, before being Ground.

FIG. 523.—Even Gum Line and uneven but esthetic cutting Edges.

FIG. 524.—Uneven Gum Line and even but esthetic cutting Edges.

The three accompanying figures will serve to further illustrate the same points. Fig. 522 shows by plain lines the appearance of a case before an operation. In this instance the upper margin of the exposed portions of the centrals and laterals were on the same gum line, but the centrals projected beyond the cutting ends of the laterals, as shown below the dotted line. The effect of grinding these centrals so as to bring their cutting edges on the same plane as those of the laterals or nearly so is illustrated by the portion above the dotted lines.

In cases of this class, the size and general appearance of the patient should also be taken into consideration in determining the treatment. For instance, the reduction of all the incisors to near one plane by grinding would be more harmonious in a short, stout person with a round head, than longer teeth (see Fig. 524); but in the case of a tall figure with narrow head, it would be better to leave the centrals projecting somewhat longer than the laterals.

If the exposed portion of the crowns of the centrals should begin above the plane of the gum line of the laterals, as in Fig. 524, even if their cutting ends were ground so as not to project much beyond the cutting ends of the laterals, shown by the hair line, and the gums should be exposed, the ends of the former would appear to the casual vision to project farther below the latter because of their greater length upward. But if the gums are not exposed, especially in the mouth of a tall, slender person with a narrow head, the centrals would appear too short. In such instances, as is the case when the gum line of the centrals is on the same plane as that of the laterals, the cutting edges only should be regarded.

"*Trueing-up.*"—As has been already said, this is the term applied to the real or apparent removal of overlapping portions of teeth in such a manner that they will (to the

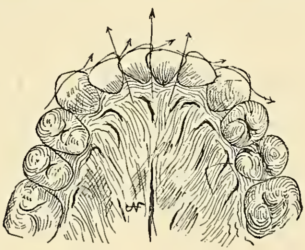


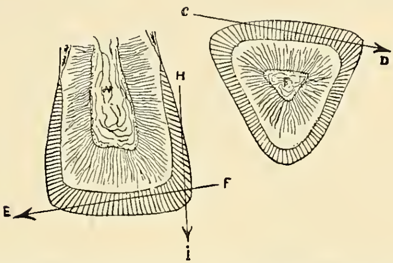
Fig. 525.—Showing the Art of "Trueing-up."

ordinary observer at a short distance) appear to stand parallel with each other. The theory of this is illustrated in Fig. 525, where the arrows indicate the line to which the overlapping and projecting portions may be ground away.

The extent of beneficial change in the appearance that can be attained by this operation cannot be adequately shown in a picture. In fact, a degree of grinding that would in some cases bring about a marked improvement would be impossible to show at all in an engraving. Again, that degree or kind of change which would make the teeth of one individual look best might not be the proper one for another; yet sufficient, I trust, may be understood from these chapters to enable the reader to see that great benefit can be derived from judicious reshaping of the teeth.

In olden times, and until of late, the instruments used for this purpose consisted of files, but these are not as effective as corundum wheels and emery paper discs. For trueing-up the sides of tilting or overlapping teeth, nothing is superior to thin hard-rubber and corundum; but when this is used to remove an overlapping portion it is important to avoid injuring adjacent teeth. This may be prevented by a slow and careful movement of the wheel around the approximal curvatures of the teeth, turning the wheel with a *firm hand* in any direction that is necessary to serve the end in view.

It is important to ascertain the extent to which a tooth may be ground without injury; in no case, except perhaps on the ends of teeth, is it proper to grind through the enamel. As every dentist knows, the thickness of the enamel varies in different teeth, and also at different points of the same tooth; thickest on the antagonizing portion of the crown, it thins out to a "knife edge" at the neck, so that, happily, where the need of griuding is greatest, there the enamel is thickest. Apprehension of injury from grinding may be materially reduced when we consider that teeth are worn by use on the antagonizing surfaces, and that the perpendicular walls of teeth are not saved so much by thickness of the enamel as by its smoothness. To expose the dentine, however, except perhaps at the antagonizing end of the tooth, is, in my opinion, not justifiable under any circumstances. This caution is necessary not only to avoid decay but also to prevent stains, which may be caused by absorption of coloring matter into the dentine, such as would result from smoking or by the use of tobacco in any way.



FIGS. 526, 527.—Section views of the Crown of a Central, showing by arrows the Extent of Grinding that is allowable

Fig. 526 illustrates a longitudinal sectional view of the crown of a central, and Fig. 527 is a cross section of the same showing the relative thicknesses of the enamel and dentine of an average tooth. As will be seen in 526 by the arrows

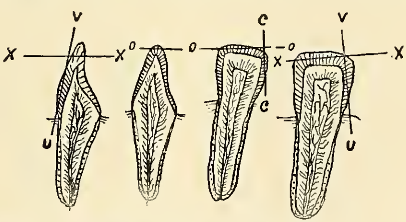


FIG. 528.—Section views of Split Teeth, showing in lines X, X, V, U, O, O, and C, C, the portions that may be ground away.

E, F, H, I, and in 527 by the arrow, C D, a considerable portion of the enamel tissue can be removed without exposing the dentine. A correct idea of the extent to which different teeth may safely be ground, can be easily obtained by splitting extracted teeth, as shown in Fig. 528, and examining the plane of fracture.

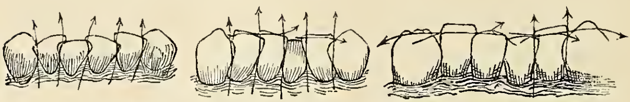


FIG. 529. FIG. 530. FIG. 531.
FIGS. 529-531.—Trueing-up and Evening Process for Beautifying the lower Teeth.

The theory of these operations for beautifying is further shown in Figs. 529, 530, and 531, which illustrate by arrows the direction of the plane of cut that will improve overlapping front teeth. In many of these instances the teeth lean in and out of the mouth so that a line drawn from the middle of the end of one tooth to the middle of the adjacent teeth and so around the arch would present a zigzag appearance, as illustrated indifferently by Fig. 532. Fig. 533 represents the same case after this operation was completed.

Referring now to Fig. 534, it will be seen that in these cases of lower teeth, even if they were shortened so as to

FIG. 532.—Before Operation.

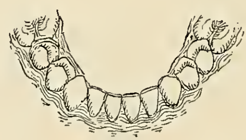


FIG. 533.—After Operation.

be even and uniform in length, when seen from a point on a plane at right angles with them as at B, and although the sides might be "trued-up" so as to appear nearly or quite parallel to each other, the teeth would still appear irregular the moment they were seen from a point above this plane, B C, as, for instance, if seen from the point A. To bring about apparent correction of this irregularity, the teeth that incline posteriorly to others should be ground on their lingual angles D, so that this portion will not be seen when the teeth are viewed from along the line A D, or even from the line A E. Of course, the anterior face of the tooth at C should be left unchanged. In this way, the top plane of the tooth will be on the line C E, and out of view.

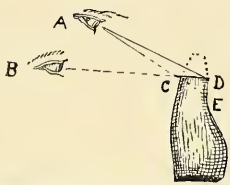


FIG. 534.—Philosophy of Grinding to obtain Optical Illusion.

A perfect operation, however, implies that the front and highest portion should not be ground so thin as to become frail, as it would be liable to nick when biting hard food: in other words, it should always be left strong enough not to crumble. Before leaving the case, the approximal corners of the tooth should also be slightly rounded off.

When a tooth inclines outward, the appearance of regularity can often be attained in a measure by grinding away more or less of the anterior portion of the tooth, as shown to an exaggerated degree by the arrow O, on the tooth marked T in Fig. 504.

In performing these operations, it is important to take frequent observations of the teeth from different points of view, and proceed accordingly, the object being to do away with as much of the appearance of irregularity as possible.

Teeth that are but slightly overcrowded may be liberated by grinding away a small portion of the enamel from the surfaces at the point of interference. This not only liberates the teeth, but also prevents decay; but this grinding should not be carried to the extent that would cause broad flat surfaces to come in contact. When the grinding is done with a view to removing the overlapping portion of the teeth, by the "trueing-up" process, especially if cavities exist, not only is the appearance of irregularity removed in great degree, if not wholly, but the teeth are also left in a better condition for preservation and the cavities are easier to fill. To fill a cavity and leave a tooth overlapping when the lap can be ground away without injury, not only permits the irregularity to remain, but the cause of the decay also; a condition that, I think, is neither in accordance with esthetics nor scientific skill.

The degree of improvement of the teeth that is possible by the process of grinding may be indicated by relating the satisfactory experience of a lady who, although otherwise of attractive appearance, had so many irregular teeth as to cause a disfigurement that was a serious drawback to her in society. The apices of the roots were apparently not far out of their proper places, but nearly all the crowns inclined one way or another, overlapping each other so that the irregularity appeared greater than it was in reality; so much so that she despaired of ever being able to have them improved. Upon hearing of the grinding process, however, she decided to have it tried upon her teeth. Watching the operation in a mirror, as tooth after tooth assumed a new shape, she became more and more delighted, until, at the end of an hour, when the work was completed, she exclaimed with gladness that can hardly be described, "What a wonderful improvement! I could not have believed it possible." Such expressions are of almost daily occurrence among those who have experienced this improvement.

Trueing faulty Lines of the Dental Arch.—From various causes, the line of the antagonizing ends of the teeth sometimes appears to be lower on one side of the jaw than on the other, making the dental arch seem "lopsided." This may be from real deformity of the jaw, as shown in Fig. 535, or it may be due to an optical illusion, as shown in Fig. 537. When illusory, it is caused by the

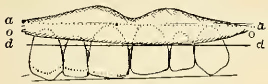


FIG. 535.—Alveolar Deformity.

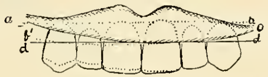


FIG. 537.—Deformity from Unequal Muscular Action.

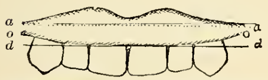


FIG. 536.—Appearance after having Ground the Teeth.

FIG. 538.—Appearance as corrected by Grinding the Teeth.

uneven action of the muscles controlling the two sides of the lip. This is shown (in Fig. 537) by the elevation of the (patient's) right side of the upper lip, rising from the dotted line *o b′* to the line *o a*. This difference of muscular contraction of the lips on opposite sides of the face, while speaking or laughing, may arise from the habit of holding a cigar or of talking through one side of the mouth, or it may, as in the case of other muscles of the two sides of the body, be due to a difference in the normal degrees of muscular power on the two sides of the face, or it may arise from partial paralysis.

If the phenomena be real, it is due to structural deformity of the jaw or the alveolar ridge, or length of the visible portion of the teeth.

In these cases the antagonism may be perfect throughout the arch, or it may be so on one side only. If, in addition to structural deformity, there should be uneven action of the lips, it is evident that this would increase the appearance of deformity, or render it partially or wholly unnoticeable, depending upon the side on which the greater muscular action is manifested.

Treatment.—As in cases where one eye is on a higher plane than the other, the defect is rendered less noticeable by combing the hair so that the height of the forehead measured between the eyes and the hair will be equal, in the same manner these dental defects, whether occasioned by optical illusion or by real structural deformity, can be rendered almost unnoticeable by shortening and reshaping the teeth that are most exposed, so as to create an impression that the arches are equal. This improvement is illustrated in a moderate degree by Figs. 536 and 538. The line *d d* in Fig. 535 shows the base line by which the grinding of the teeth is governed. The amount of tooth tissue that is ground away is shown below the dotted lines in the same figure. The appearance of the case, after the operations, is shown in Fig. 536. In the case shown in Fig. 537, the proper line of the lip should be *o b′*, but owing to unequal power of the labial muscles, the right side contracts from the dotted line *o b′* to *o a*; therefore, the measurement for grinding is gauged from the lip instead of the line *d d*; the amount of tooth tissue ground away is illustrated below the dotted line near the cutting edges. The appearance of this case after the operation is shown in Fig. 538.

In some cases the grinding may be confined to the anterior teeth, but (in others) the balancing of the two sides of the arch can only be satisfactorily secured by grinding the side teeth also. It is not necessary, however, to disturb the antagonism in correcting cases of this kind. The shortening of overhanging front teeth will not alter this relation, and the alteration of the bicuspids may be confined to the outer cusps.

Polishing Teeth after Grinding.—Having finished the grinding process (wherever it may have been performed), the portion ground should be highly polished. This may be done with a fine Arkansas stone or some kind of gritty

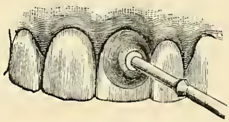


FIG. 539.—Polishing the Teeth.

powder, but wheels cut out of emery paper are far superior. These wheels will not only polish more beautifully than stone or powder, but will do it much more rapidly. They may be cut from emery or ruby paper with a gunsmith's or tinsmith's punch, but a superior wheel is cut from a centre

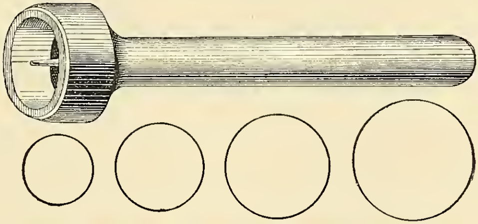


FIG. 540.—Centre-punch for cutting Paper Polishing-wheels (Stevens).

punch, such for instance as the one devised by Dr. S. G. Stevens (1882). To increase the strength of the paper, and to prevent it in a measure from being rapidly soaked with saliva, it should at least be varnished, on the back, with shellac dissolved in alcohol. The rule is, to apply evenly two coats of the varnish, letting the first coat dry thoroughly before

34

applying the second. Some discs may also (profitably) have one coat of varnish applied to the gritty side of the paper. The paper is then laid (emery side down) upon a heavy block of hard wood, and then the discs are stamped out with the cutter by striking it one heavy blow with a hammer. Dr. Stevens's directions are as follows :—

"Give all except the very fine grades one coat of shellac varnish on the sand side. When dry, tack the sheets on some flat surface, sand side down, to prevent curling. Give the backs three or more coats of shellac and let them dry thoroughly. Place the sand side down and use a wooden mallet to strike the cutter."

Another writer, whose name I have not heard, recommends that to prevent these paper discs from curling, they should be strung and packed down tightly on wire pins set in a piece of board, or placed in holes made in a thick block of wood, and held there firmly by spiral springs.

CHAPTER L.

LIBERATING TEETH BY GRINDING THOSE THAT ARE IMPROPERLY LOCKED IN ANTAGONISM.

GENERAL CONSIDERATION OF THE SUBJECT.—SPECIAL CONSIDERATION.—CASES.

THERE are cases of irregularity that are maintained, if not brought about, by improper locking of the cusps in the antagonism of the teeth. Although sometimes resulting from a complication of causes, these wrong lockings are generally attributable to one of four:—1st, the retention of teeth that should have been extracted or moved to make room: 2d, the premature loss of some of the deciduous teeth, allowing the adult teeth to straggle into their places; 3d, interference of supernumerary teeth by crowding between or alongside, forcing other teeth out of place; 4th, improper occlusion of the jaws forcing the teeth out of place. As these conditions cannot be treated independently without considerable repetition, they will be dealt with collectively.

These cases of irregularity are generally found to be located anterior to the molars, and may be divided into two classes, those of simple and those of complex origin. When a tooth is moved out of position from want of sufficient lock with the opposing tooth, leaving a gap behind, the causes may be said to be simple; but if a tooth, as for instance, an unerupted adult cuspid, be forced to erupt out of position because a bicuspid has previously taken the territory belonging to it by reason of premature loss of the deciduous cuspid, though the position may be similar to that of the above case, the cause may be said to be complex. To reiterate: this irregularity is the result of premature loss of the deciduous cuspid, followed by a bicuspid straggling into its place; and fur-

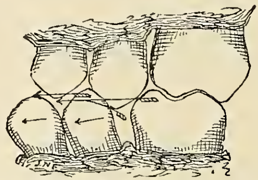


FIG. 541.—Showing Irregularity of Lower Bicuspids caused by Mal-antagonism.

ther, behind these is the first cause, the one which induced the bicuspid to straggle from its proper position (Fig. 541).

The first, or simple, class of cases of irregularities may arise from improper contact of the cusps in the period of eruption, which, acting on the principle of an inclined plane, forces the tooth out of place; or perhaps the irregularity may occur later in life, when the loss of some of the neighboring teeth may have permitted an obliquely directed force, (which previously was not strong enough to effect any injury,) to push against remaining adjacent teeth with sufficient power to move them. When adjacent teeth stand against others, they are mutually supported in the work of mastication, but when the ranks are broken by loss of a tooth, the adjacent one tilts over in a manner that would have been impossible, had the missing member remained to take its share of the forces of antagonism.

If it is desirable to avoid using devices, the treatment of interfering cusps lies in arresting the pressure, changing the direction of the force upon them by grinding out the lock, varying the level of the cusps, or by doing away with the antagonism altogether. If done in season, this is easily accomplished; but when the irregularity results from loss of neighboring (adult) teeth, especially the molars, later in life, this is not always the best plan of treatment.

Indeed, it may be impossible to do anything except to right up and place the inclining teeth in proper position by devices, and then substitute something for those that are missing. Although this is easy for experienced operators to decide, those who are inexperienced are apt to doubt and hesitate in a manner that leads observing patients to suspect a want of skill, and so, owing to the hesitancy on both sides, nothing is attempted until perhaps the case has become still more difficult of correction.

If an operator is doubtful as to the best plan of procedure, it is better to postpone the operation and study the case than to act rashly and treat the case in an experimental way, taking the risk of failure. For, when the conditions are thoroughly understood, it is much easier to devise a plan for successful treatment than when working comparatively in the dark.

Special Consideration of the Subject.—The only practical rule that can be laid down for preventing teeth from forcing others out of place, is, if possible, to remove the cause before much mischief has been done, or, if too late for that, then to remove it as soon as practicable. This may be accomplished by the use of inclined planes, but generally, as well if not better, by artistic reshaping of the teeth by a judicious use of the corundum-wheel.

As it is difficult to explain this subject clearly in the abstract, I will illustrate it by cases in practice; first by that of a boy about twelve years old. Having prematurely lost his right lower deciduous cuspid, a right upper bicuspid antagonized with the lower bicuspids in such a manner that the lower first bicuspid (which had erupted prematurely), was forced forward, so that it stood on the ground of the adult cuspid, compelling the latter to make its appearance outside of the esthetic line. An interesting feature in this case was the absence of the first adult molar, which although sound had been extracted by one of the men who are said to have "a habit of taking out the sixth-year molars." It is needless to say that, under such circumstances, the extraction of this molar did not correct the fault. The general appearance of the case may be stated thus: there was a space between the second bicuspid and second adult molar of considerable breadth, and to this was added a jumbled arrangement of the teeth (Fig. 542).

Careful examination detected that the cusps of the upper bicuspids (the arch being full), antagonized in such a manner

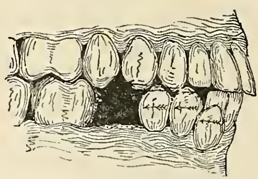


FIG. 542.—Malposition of three Teeth from wrong Locking of the Cusps of the Bicuspids. (Case I.).

with the lower teeth in question as to act upon them like an inclined plane, forcing them forward about an eighth of an inch, and holding them fast; in other words, the cusps were locked into the wrong places.

Treatment.—The lock was done away with by shortening the interfering cusps with a corundum-wheel. This is indicated in the figure by unfeathered arrows. After grinding out the lock, the teeth were rounded off and reshaped, but not so as to disfigure them. In a few weeks, without further effort the lower bicuspids had moved backward in the direction indicated by the feathered arrows, thus making room for the cuspid, which also had followed and moved into its proper place. The irregularity had disappeared without the aid of any other device than the corundum-wheel. Of course, the teeth could have been drawn back without grinding.

Case II.—Fig. 543 illustrates the case of a girl of twelve years, in which the right lower adult cuspid and two bicuspids were overcrowded. These teeth were inclined forward and overlapped, probably the result of too early loss of the deciduous molars. The bicuspids had begun to decay on their approximal surfaces; the first adult molar also was

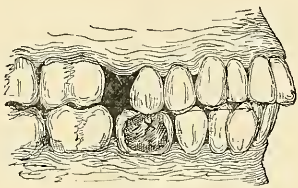


Fig. 543.—Teeth Improperly Locked. (Case II.)

extensively decayed in several places. The cusps of the two bicuspids, which were long and pointed, locked between each other in such a manner that the upper held the lower, firmly, in the wrong places. The first step in this case, after filling the cavities in the bicuspids, was to make room for the overcrowded teeth by the extraction of the first molar, and the second was to liberate them by grinding away the interfering cusps (indicated in the figure by the hair line) of all of the bicuspids sufficiently to overcome the lock. The case was then left to nature for nearly a year, when, finding that the teeth had moved back only about half the desired distance, they were forced back by a screw clamp-band placed around them and the posterior molars, (the latter serving as anchorage,) and then tightened once or twice daily.

Auxiliaries.—The instruments to be used may differ according to circumstances; in some cases, inclined planes to keep the jaws apart, and at the same time to help in forcing the teeth along, will do; in others, where there are

FIG. 544.—Antagonizing Wart-Plugs, and Thimble-Crown.

cavities in the antagonizing surfaces, wart-plugs (see Fig. 544), so shaped as to keep the jaws apart, and at the same time influence them to slide in the required direction, are less clumsy and equally effective; but gold thimble-crowns are more efficient than either of these. These crowns (which should, of course, have their antagonizing surfaces so shaped as to hold and guide the teeth in the desired direction) must be cemented on the teeth with phosphate of zinc, as shown in the figure at the right.

CHAPTER LI.

EVENING THE ENDS OF TEETH.

IMPROVING THE APPEARANCE AND ANTAGONISM OF TEETH WORN OUT OF NORMAL SHAPE.—GENERAL REMARKS.

FREQUENTLY teeth that are regular, so far as being on the esthetic line is concerned, are individually ill-shaped. There are but few middle-aged people whose teeth are not more or less worn out of their normal form, and the teeth of the young are not always exempt from this wearing. It may result from improper antagonism, from a habit of chewing gum, tobacco, or pipe-stems, or by unconscious grinding of the teeth while asleep. In some cases it is so slight as to be unnoticeable, while in others it is so great as to be not only unsightly but destructive of usefulness. The teeth, especially the upper incisors, belong to the principal features of the face, and have their part to play in expressing character, as truly as do the eyes, nose, or chin, so that if they are ill-shaped, they mar the entire face. A remarkable instance of this defect came to my notice in a gentleman about seventy years of age, whose teeth, although not decayed, were so worn into notches (from one-fourth to three-eighths of an inch deep) that when the jaws were closed the opposite teeth fitted into each other like those of a steel trap. I have seen several still more remarkable cases of worn teeth—for instance, that of a gentleman about forty-five years of age, whose entire set of teeth were so much worn down that the act of eating caused the gums to bleed.

Between these extremes, all degrees of disfigurement exist; in some cases front teeth are worn straight across, while others are beveled this way or that, or perhaps are of a gable-end and roof shape, sometimes notched in the middle, leaving long angular corners; others still are broken and ragged, some worn shorter than others, thus presenting a disfigurement that in degree is equal to, if not greater than, that caused by irregularity in the position of teeth.

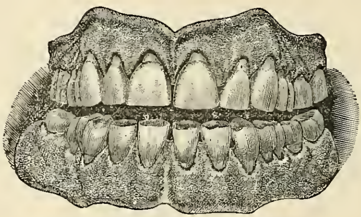


FIG. 545.—Imitation of worn Teeth (Flagg).

In truth, esthetically speaking, these teeth exhibit a real deformity and an "ancientness" that should be corrected. To be sure, to say that unworn teeth would appear natural at all ages would be untrue, for in advanced life, when all the outlines of the face vary more or less from those that belong to youth, teeth that are somewhat worn correspond and harmonize better with the surrounding conditions. So, on the other hand, unevenness of the teeth, suggesting long wear, would appear unnatural in youth, which implies everything new. Notwithstanding this, however, much may be done toward rejuvenating the face in advanced age by doing away in some degree with the raggedness from wear and restoring the outline of the teeth in a measure without going so far as to cause an inharmonious or unnatural appearance. It is sometimes thought necessary to introduce this evidence of age, derived from worn edges, into artificial teeth, so as to give a more natural appearance to such dentures (see Fig. 545), but I think this may be easily carried to a point beyond esthetic taste.

An additional reason for grinding irregular and ragged teeth is that they act like a hetchel upon those opposite to them, wearing them away much more rapidly than if they were smooth. The time that this treatment is especially

Fig. 546.—Worn Teeth.

called for is when the incisors and cuspids are so worn away that the labial enamel is left very thin and sharp, so thin that it nicks out and resembles saw teeth (as shown in Fig. 546). It is important to grind these "feather edges" away, so that the enamel will be left stubbed, strong, and smooth; by this means they are made more durable.

In this illustration of the upper incisors (Fig. 546) the dotted lines show the extent of the wasted portion.

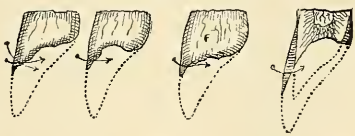


Fig. 547. Fig. 548. Fig. 549. Fig. 550.
Fig. 547–550.—Showing the minimum degree to which worn Teeth should be Ground.

Fig. 547–549 are side views, and Fig. 550 a sectional view of four centrals, showing by dotted lines the extent of tissue which is often found worn away in these cases, where from loss of the side teeth mastication devolves upon them.

The arrows indicate the minimum degree to which such teeth should be ground. Sometimes this wearing away of the teeth is due to too powerful muscular action, which grinds the teeth more in cases where the tissues are softer than in those of average hardness. However this may be, the remedy is either to restore in a measure their original form with some sort of filling material, such as gold, amalgam, or porcelain, or to grind them shorter to resemble the normal, but evenly worn shape. In some cases, the first-mentioned operation, called "shoeing," is practicable, and

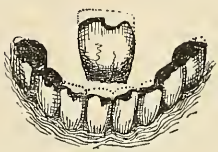


Fig. 551.—Appearance before being Ground. Dotted lines indicate the original shape. (Case I.).

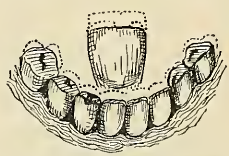


Fig. 552.—Appearance after being Ground (Case II.).

when skillfully performed, constitutes one of the best plans of correcting the deformity. It is sometimes necessary for teeth worn as shown in Fig. 551 to be thus shod, after having been ground as suggested; but, when the teeth are not too much worn and the case will permit, simply reshaping the antagonizing surfaces is superior to all other plans, because the improvement is not effected by adding anything which may be criticized as faulty, but is brought about by taking away something that will not be missed, leaving the remainder not only in better shape than before, but also rendering the opposing teeth less liable to wear on each other. This art does its work and covers its tracks so skillfully that an acquaintance sees no trace of the process, but quickly notices that the patient's appearance is more youthful.

Fig. 551 illustrates a case in which the teeth are worn from the shape shown by dotted lines.

Fig. 552 represents a similar case after grinding; the original form before being worn is shown also by dotted lines. The large incisor in Fig. 552 illustrates by dotted

FIG. 553.—Teeth Reshaped, dotted Lines showing original Shape (Case III.).

lines the previous shapes, the original and that acquired from being worn away; by the plain lines, the shape after being ground.

Fig. 553 shows by plain lines a case after operation, the lower dotted lines showing the portion that has been ground away ; the upper dotted lines, the original shape.

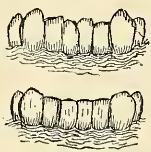


FIG. 554.—Teeth before and after Reshaping (Case IV.).

Fig. 554 illustrates still another case of irregularly worn front under teeth, and also the appearance of the same case after the beautifying operation.

The process of reshaping is in some respects the same as that which has been explained in the Chapter on Apparent Correction of Irregularities by Reshaping the Teeth, in which the treatment has especial reference to the correction of teeth that stand irregularly, inclining this way or that, and overlapping each other, while in this chapter we refer to cases that have become irregular in shape by wear. In this class we deal only with the antagonizing ends, confining the operation principally to the incisors, cuspids, and bicuspids, but it is applicable to the molars, when so worn that the antagonism is imperfect.

Before beginning the beautifying process, the teeth should be examined carefully to ascertain the bearings of the opposing teeth, as explained in the chapter above referred to; and then, choosing as a base line of measurement the shortest and most worn front tooth, the others should be ground to approximate it as closely as is prudent, with the view of making the antagonizing ends even with those of their neighbors of the same jaw, after which the corners should be rounded off to a degree corresponding with the age of the patient, bearing in mind the fact that, in youth, the antagonizing surface lines of the anterior teeth are more curved and the corners more rounded than is the case in later life. While the more pronounced curvature is in harmony with youth, the line should approximate more and more to straightness in proportion to the increase in age of the patient, but not to the extent of absolutely straight lines and square corners.

Although the shortest front tooth should be taken as a guide or basal point to work from, I do not intend to imply that in all cases the teeth to be reshaped should be ground exactly to a level with it, because this would in many cases shorten them too much, so that the general effect would not be as harmonious as if they were left somewhat longer. In such cases, to leave a single tooth or even two teeth rather shorter than their neighbors, would not be particularly noticeable. A better plan, in most instances, is to grind the teeth so as to approximate the short one by gradation, allowing the adjacent tooth to remain a trifle longer, the next longer still, and so on around to the first molar, but, of course, not interfering with the antagonism of the bicuspids. Having shaped the teeth to taste, by grinding, they should then be polished with discs of emery paper, made as explained in a previous chapter. See page 529.[1]

In this operation, the antagonism of the front teeth cannot always be made perfect, nor is it necessary in all cases. As before stated, I think that in this matter, the preservation of antagonism of incisor teeth, where there are side teeth to masticate with, is not so important as the improvement of personal appearance, since mastication and consequently health, would not under such circumstances depend on the incisors. I have followed this method of correction almost daily for many years in adult cases, and although I do not usually pay much attention to the antagonism of the incisor teeth, I have never seen a case where they have risen from the socket as a consequence of removal of actual contact, nor have I ever seen a case where it has proved detrimental in any way. In cases of children, however, before the teeth are fully erupted, the matter is quite different; the teeth under these circumstances might continue to rise as if in search of an antagonizer. But as this point of the rising of teeth is fully dealt with under its appropriate head, it is unnecessary to treat it further here.[2]

In adult cases, as before said, when this operation is skillfully performed, the teeth not only remain in their place, but the wearing away of the tissue is also effectually stopped. Thus the teeth are not only improved in appearance, but are also saved from destruction.

---

[1] The originator of the emery disc, so far as I know, was Dr. I. Emory Scott, who devised them in the spring of 1880. Dr. R. Finley Hunt presented me at that time with some of the first that Dr. Scott made.

[2] See Part XVII., Vol. 2.

CHAPTER LII.

ANTAGONISM IMPROVED BY GRINDING.

REMOVING INTERFERING CUSPS.—PREVENTION OF THE SPLITTING OF BICUSPIDS.

TEETH antagonizing so imperfectly as to be worthless for masticating purposes are more common than is generally supposed. They are to be found at all ages, from childhood onward. Besides the loss of antagonizing teeth, there are two other causes of failure in masticating, namely, long cusps, and cusps that are greatly worn. Sometimes, also, there is a difficulty arising from the erup-

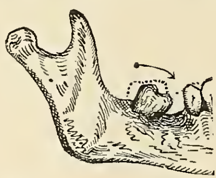


FIG. 555.—Tilting of a Tooth from lack of lateral Support.

tion of teeth in an abnormal position, from lack of lateral support, through the loss of some of the adjacent teeth, allowing those subsequently erupting to take their places; and being of different size and form, they do not match their opponents. Teeth which tilt over from lack of lateral support, as shown in Fig. 555, often antagonize at only one or two points, some striking their opponents on a line with their long axes, others obliquely—at different angles, Some antagonize on the sides, in such wise as to drive one or both forcibly against adjacent teeth, if present, or perhaps to one side and out of place. Besides tending to cause decay, this crowding, when the teeth are forced out of line, is more or less detrimental to health as well as to personal appearance. To remedy this defect, different plans are advocated by operators, as extraction, grinding away interfering points, and moving the teeth by mechanical force. The first of these methods of treatment will be explained in Part XIV.

FIG. 556.—Teeth that need Grinding to improve Mastication.

Many molars are so peculiarly shaped by nature, that the antagonizing surfaces are very ill-adapted to mastication. These teeth have very long and irregular cusps, which often interlock in such a manner as either to strike obliquely and force each other out of line, or to antagonize only on their points, thus rendering proper comminution of meat foods impossible. Fig. 556 illustrates one form of teeth of this class.

Besides this variety of teeth there are molars found in middle and later life which, by being worn out of shape, are rendered inefficient. These become irregular by wearing of the enamel entirely away in some places and not in others, thus in such places exposing the dentine, which, being softer than the enamel, rapidly wears into pocket-like places, that often become deep enough to collect and hold seeds, to the great annoyance of the patient.

To improve some of these teeth, the pits may be modified in shape, and then filled with gold or amalgam. In many cases, however, filling is not so efficacious as grinding away a considerable portion of the prominent points around them. The latter operation may also be said to be proper in the class of teeth referred to as having grooves and very irregular cusps. Where there are crown cavities caused by decay, they should of course be filled, the operation being extended until the hollows between the long cusps are also partially filled; but, even in these cases, grinding away sharp points of the cusps and other prominences will sometimes improve mastication. In the case of teeth that are so malformed as to be very irregular on the antagonizing surfaces because of pits and grooves, I do not hesitate to grind the tooth smooth whenever the patient is able to endure the noise of the operation. Of course, this is not intended to sanction a reckless use of the corundum-wheel, or the destruction of antagonism by grinding teeth too short.

Prevention of the Splitting of Bicuspids.—One of the most important benefits arising from grinding the antagonizing surfaces of teeth is the prevention of splitting bicuspids, which by partial decay have become so weakened as to be rendered unfit to bear the normal degree of strain during mastication. The cusps of these teeth, especially those of the upper jaw, are often so wedged by their antagonists as to be in danger of splitting apart, more so than any others, owing to the bifurcated formation of these teeth, and the peculiar antagonism with the opposite teeth, which, (in the case of the lower set), are sometimes shaped more like cuspids than bicuspids (see Fig. 557), nor does the splitting always have its primary cause in decay; for, so great is the wedging stress upon these teeth, when accidentally biting upon hard substances, or when the loss of the molars allows the antagonism to fall much more heavily upon these teeth than is normal, that they break away even when sound. Sometimes the lingual cusp splits off; at others the buccal cusp. When it is the former, there is frequently a possibility that the remainder of the tooth may be smoothed and left self-cleansing, without causing visible disfigurement, but when it is the outer, and the fracture is exposed to view, the case is quite different; for, unless the

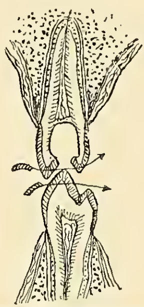


FIG. 557.—Showing the Liability of Bicuspids to Split by Wedging Antagonism.

part can be artificially replaced, which is difficult, the patient is permanently disfigured by the accident.

If there is any truth in the old saying, "An ounce of prevention is worth a pound of cure," it will apply here; for, by a little grinding and reshaping, so that there would be no possibility of the lower tooth antagonizing like a wedge between the two cusps of the upper tooth, splitting would not occur even if the tooth should be considerably weakened by decay. This statement, being applicable, also, to teeth forced out of line, will be referred to again.

To prevent such injury to weak teeth, it is not enough to grind so as barely to prevent contact between the cusps, but, if possible, without causing unsightliness, the cusps should be ground so as to do away with all lateral strain, and in a measure with the view of making the teeth antagonize more like molars—that is to say, squarely but lightly if at all upon each other, the plane of cut being somewhat as indicated by arrows in Fig. 557. Of course, this remedy should be applied judiciously; each case being governed by surrounding circumstances. If the teeth are sound, they do not require so much grinding as when weakened by decay. Much, also, depends upon the bearings of the other teeth. If the antagonism of the molars is broken or lost, then the grinding should be such as to distribute the force of the bearing all along the line of the remaining teeth, but so that the antagonism will bear more on the stronger than on the weaker teeth. This should be done without causing any tooth to move out of position, which would give rise to irregularity.

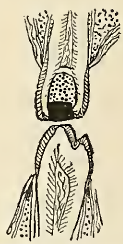


FIG. 558.—Showing how to prevent Splitting by doing away with the Wedging Antagonism.

When the teeth are decayed between the cusps, the filling should be inserted and all left slightly short with a view to its withstanding as great a degree of force from the antagonism as the tooth is liable to receive from its rising to contact, should such rising occur. This implies not only the filling of the lower portion of the cavity with cement, a firm base that will not tend to split the tooth, but to serve as a strong support to the plug above it. To protect the enamel, the plug should be built flush, or perhaps somewhat "warted," to receive the main portion of the resistance of food in mastication (see Fig. 558).

In living teeth, as here illustrated, this cement base may serve also to protect the soft dentine over the pulp, or as a capping if exposed. Having done all that is possible, the patient should be informed as to the importance of care in masticating upon such teeth, and especially of avoiding biting upon hard substances.[1]

Interfering Cusps.—In correcting irregularities by moving the teeth, especially where some of them are extracted to relieve overcrowding, proper antagonism is sometimes impossible without grinding down some one or more interfering cusps. This grinding is heresy in the opinion of some people; but, where the plan is judiciously carried out, it sometimes secures better results than any other. In fact, teeth should be both beautiful and useful, and when these ends can be attained without injury, I think it is better than to lose both teeth and beauty, by trying to preserve the original shape. Grinding affects the teeth exactly as does long use of them; the points of antagonism wear away, in one case by the corundum-wheel, in the other by the masticatory process. In the grinding operation (which I think is one of the most valuable known to dentistry, when skillfully performed), the dentist should first carefully determine by examination the bearings of the different teeth upon each other. This may be ascertained by requiring the patient to bite upon "antagonizing paper;" which leaves color, and enables the operator to see where grinding is necessary and where it is not. This paper, now purchasable in common market, distinctly shows every point of contact on both the upper and lower teeth. Which tooth should be selected for grinding depends upon circumstances. Not only the direc-

[1] For explanation of the capping process, see p. 400.

tion in which it bears noted, but also whether the grinding can be done without injury to appearance. If the antagonism has driven the tooth or its opponent out of line, one or both of the teeth should, of course, be ground so as to liberate them; but the one that will be least injured should receive the main if not the entire treatment. If, by a point of contact, the tooth can be enabled to take a better position by grinding out one side of a lock, this point of interference should be allowed to remain. It is a nice question to decide, for one point of contact would often be of service if it were not opposed by some other.

In cases of molar teeth, where a lower member inclines

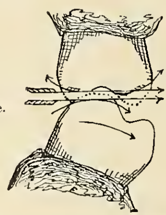


FIG. 559.—Showing improper Antagonism of Molar Teeth, causing the lower to move toward the Tongue.

toward the tongue, the upper tooth is often found to antagonize on one side of the outer cusps or on the buccal side of the (lower) tooth in such a manner as to cause this tooth to incline inward still more.

To do away with these defects, the lower tooth should either be moved outward and righted-up so as to allow the grinding surface to antagonize properly with its mate, or be ground so as to remove the main pressure from the lower tooth by reshaping portions of the cusps of the upper, or possibly of both ; or (perhaps better) remove all contact, as indicated in the figure, with a view of allowing nature an opportunity of righting-up the lower tooth. The portions of the teeth to be ground away to overcome such diagonal antagonism are shown by dotted lines and arrows in Fig. 559.

While on this subject, it may be well briefly to call attention to the tilting of teeth in the operation of moving them, before they are fully developed. Anchor teeth should be watched closely in order to avoid causing them to fall over, or to start from their sockets. This action of the tooth is not desirable, yet slight deviations need not cause alarm ; for, if the bearing upon the tooth be removed or changed to other teeth, it will, generally speaking, soon afterward return to its former position.

If, however, after several weeks' trial, it has not righted itself, the tooth may be forced back to an upright position by biting upon a lever device attached to the tilted tooth, to be explained later.

What has been said of the molars is also frequently true of other side teeth that incline out of position. Where a bicuspid is missing, and the arch is filled with teeth all in regular line, but inclining along the line, the grinding of such points is not only a rapid but a very satisfactory operation, but when teeth are scattered, it may be more difficult, because teeth standing alone are more apt to tilt if the antagonism is not exact. Occasionally cases occur in which the arches are full, and there are no spaces between any of the teeth, and yet the cusps ride upon each other as shown in Fig. 560.

In such cases as these, proper antagonism is thought to be brought about by extracting a tooth and moving the remainder along, or by enlarging one arch, but I think judicious grinding, as indicated by arrows in Fig. 560, is not only the easiest but sometimes the best plan.

When front teeth antagonize unevenly, those which are subjected to the most pressure are liable to move out of line.

This movement may be in an anterior and posterior direction, as shown in Fig. 561, or it may be in a lateral direction, depending upon the direction of the force applied. Especially is this lateral displacement liable to occur in cases where an adjacent tooth is missing. Teeth that have pre-

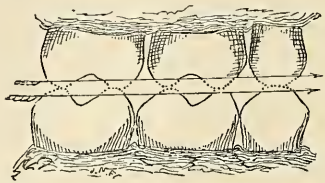


FIG. 560.—Improper Antagonism corrected by Grinding.

viously been regular sometimes suddenly surprise the patient by beginning to move out of line after the molar teeth are lost, or when the side teeth have become so broken down from decay and wear that the force of mastication falls mainly upon the front teeth, as is often the case in advanced age, causing protrusion of the lips. This re-

FIG. 561.—Movement of Teeth in different directions, caused by Antagonism.

semblance to old age may be brought about in earlier life by grinding the bicuspids and molars to such an extent as to allow the bearings to fall too much upon the front teeth.

If these anterior teeth do not antagonize, as is often the case, no harm will follow ; but, if they antagonize, and it becomes necessary to shorten the side teeth for any reason, it will be seen that, unless it be desirable to force the anterior teeth into a different position to fill out the lip, these front teeth, also, should be ground.

In early adult life, when inclined side teeth need righting-up, and it is not practicable to do so by moving them, one may be ground at a time, allowing the bearings upon the other side teeth to remain until this change has taken place; when others in turn may be similarly ground, and so on around the arch. But, if the front upper teeth are too crowded, and it is desirable to separate them a little, or if a tooth stands in the posterior position, such teeth may sometimes, as before said, be moved out by relieving the antagonism elsewhere, so that the main pressure will fall upon these front teeth. But this operation should be performed with great care; and the front teeth should be specially watched, in order to see that they are not driven too far forward or otherwise out of position.

CHAPTER LIII.

ABNORMAL RELATION OF THE JAWS.

LATERAL DISPLACEMENT OF THE LOWER JAW CAUSED BY IMPROPER ANTAGONISM.—TREATMENT.

DEFORMITY from abnormal relation of the jaws differs from that of the teeth alone, in that it involves an entire jaw and is usually confined to the lower. The displacement of the lower jaw in any direction is a deformity, (though not always caused wholly by improper antagonism of the teeth); and thousands of people, thinking this an irremediable defect, go through life with it, when it might easily be corrected. In this and the succeeding chapters of this Part it is my purpose to point out and explain some of the causes of various directions of displacement and the remedy for these deformities, whether they be recent or old.

Occasionally an abnormal arrangement of the teeth causes the lower jaw to occlude to one side of the normal position; in other words, the median line between the lower incisors is on one side of that of the upper. Nor is the abnormality in the arrangement of the teeth always great; oftentimes it is so slight as to be unnoticeable, yet, as it guides the jaw to one side, it may increase. When this deformity is discovered in season, it is easily corrected by extracting the interfering tooth or teeth, or by grinding or by moving them. Of course, extraction is proper only in extreme cases, as in overcrowded arches, or when the jaw-conformation is such that some of the posterior teeth strike much too early, leaving the anterior portion wide apart. But to lay down a rigid rule and point out the exceptions, would not be easy to do, nor shall I attempt it. As to the necessity for extraction, as well as for moving teeth, judgment, after seeing the case is the only reliable guide. But upon the point of grinding, more may be said, because the plan of subjecting the patient to two or three years of experiment in the use of plates, though occasionally successful, should not, I think, be much encouraged. When the movement of the interfering tooth or teeth is not advisable, and a moderate degree of grinding will suffice to permit the jaws to oc-

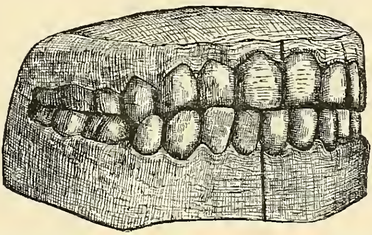


FIG. 562.—Lateral Displacement caused by improper Antagonism.

clude normally, this affords a quick and generally successful method of securing the desired effect without injury to the teeth or the health of the patient.

Fig. 562 shows one of these forms of faulty relation of the jaws that is common. In this figure the median lines of the two jaws are indicated by black marks. The deformity in the case, from which this figure was drawn, was caused by the right upper cuspid and lateral erupting so that they caught behind the edges of those of the lower jaw, and in the process of occlusion guided to one side the lower jaw, which made the face appear askew.

In nearly all similar cases, if taken before the teeth are fully developed, (say any time previous to the eighteenth year, before the joint tissues are abnormally formed and the masticating muscles have become habituated to the abnormal conditions,) a judicious grinding, sufficient to liberate the lower jaw, will generally permit nature to correct the deformity in a measure, if not wholly, within a few months. But, if the operation be not performed until the patient is thirty years of age, (when the articular tissues have become firm and strong, and the relation of the condyle of the lower jaw and the glenoid cavity of the temporal bone and the surrounding cartilage, ligaments and masticating muscles, become fixed in form and habits,) such grinding

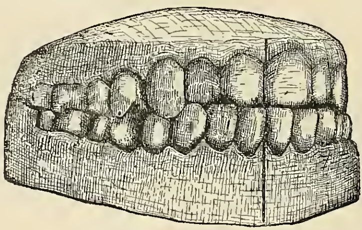


FIG. 563.—Occlusion after grinding.

will seldom be sufficient to induce the jaw to assume its proper place; nor would any other plan prove more successful.

In this case, which I undertook for a man of middle age, it was easy to make the teeth antagonize when his attention was directed to them, but the old habits of the muscles would re-assert themselves as soon as the subject passed from his mind. Nor did years of training avail much, for the reason that the changed dimensions of the different tissues, caused by years of wrong antagonism, would not readily resume their former conditions. In other words, the condyles of the lower jaw becoming fixed in their abnormal positions in the glenoid cavities, and the surrounding tissues becoming conformed to them, the habits of the muscles and tendons also becoming established, they were so difficult to break that it was impossible to correct the deformity fully.

The experiment, however, effected some good in the course of years, and a steady though slow improvement is still in progress. Even if the use of mechanical auxiliaries would be practicable in earlier life, to undertake the correction of such a deformity by moving the teeth or by a chin-cap for a man at this age in very active business life would have been absurd, because its use would not be persisted in long enough.

Whatever the case may be, and at whatever age, I would suggest that the grinding method should receive the first consideration, because it is so simple, and the operation is so quickly performed, and this too without causing the least injury. If the patient is young, and the nature of the case calls for the movement of other teeth than those which have caused the trouble, or even if the few teeth in question are out of line and require to be regulated, then esthetic considerations concerning the teeth *per se* place the matter in a different light, and one that may require movement of the organs, possibly aided by extraction of some tooth, instead of grinding.[1]

---

[1] NOTE.—There is a lateral arrangement of the teeth of the lower jaw that resembles closely the above-mentioned conditions, which arises from a wholly different cause. Instead of the condyle of the jawbone being dislocated, the *body* of the jawbone on one side *is* longer or shorter than its mate. The same appearance is also found to result from one ramus being shorter than the other. In some cases this difference in the length of the rami is very slight, but in others it is fully half an inch. The *ramus*, when examined independently of its mate, may be apparently normal in its development, or it may show imperfection, a considerable portion in the region of the condyle being largely cartilaginous. I have one specimen in my collection in which the condyle is entirely wanting, the stub showing evidence of having been slightly diseased. Such cases must, of course, be regarded as being beyond correction. See p. 584.

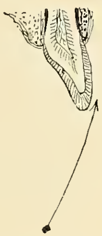
CHAPTER LIV.

ANTERIOR DISPLACEMENT OF THE LOWER JAW.

DISPLACEMENT CAUSED BY MAL-ANTAGONISM OF SIDE TEETH. —TREATMENT.

THE anterior displacement of the lower jaw sometimes arises from loss of some of the teeth, or from teeth antagonizing in such a manner that the lower jaw slides forward upon them. These sliding surfaces are generally confined to one or two cusps, but occasionally extend to include those of several teeth, the number being sometimes increased by others subsequently erupting. The antagonism of these cases is often normal until about the eighteenth year, when it is found that the lower teeth are moving forward, so that the lower incisors instead of occluding behind the upper incisors, have "jumped the bite," as it is termed, and now occlude in front. The primary cause of this late change of antagonism is generally found to be the eruption of the third molars to such an extent as to throw the lower jaw forward; sometimes, however, the cause is loss of some of the side teeth, leaving gaps into which others tilt so as to form an inclined plane, on which the jaw glides forward. Still another cause is the entire destruction of the antagonism of the side teeth—in other words, even if some of the side teeth remain, they do not meet any antagonists. This permits the jaw to form a bad habit of reaching forward, so that the anterior teeth will ride the upper teeth, until the lower ones are pushed forward or the upper ones forced backward.[1]

Diagnosis.—It has been mentioned that the diagnosis of the variety of deformities caused by interference of teeth is partially determined by placing colored antagonizing paper between them, so that, when bitten upon, the points of contact will become discolored and made visible. The accuracy of the diagnosis in these cases, however, largely depends upon carefully watching the motions of the lower jaw in the act of occlusion; the jaws being observed from the side as well as in front. If the cause of the abnormal



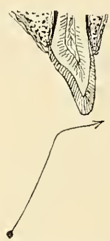


FIG. 564. FIG. 565.

FIG. 564.—Arrow showing the Arc of lower teeth with jaw at fault.
FIG. 565.—Arrow showing Arc of teeth formed by Mal-antagonism.

antagonism lies in a peculiarity in the shape of the jaw or in the articulating joint alone, the teeth of the lower jaw will move in a regular arc from the situation of a wide open mouth to its final rest in occlusion, cutting a curved line as indicated by the arrow in Fig. 564.

If the cause is interference of the cusps of the teeth, the line of arc in the act of closing the mouth will be a regular curve until the interfering teeth are brought into contact, when the lower jaw will leave this arc and glide forward,

[1] See chapter on Antagonism geometrically considered.

both directions of which movement are indicated by the arrow in Fig. 565.[1]

Treatment.—The treatment in this class of cases is, of course, to do away, if possible, with the cause of wrong antagonism. If the cause is in the teeth themselves, it may be removed by grinding, by extraction, or by righting them up. As already stated, when it lies in the posterior teeth, unless they are much decayed, extraction, except of the third molars, is not often allowable. Even these should sometimes be saved, when moving them forward into the places of lost or badly decayed second molars is practicable, and at the same time will overcome the difficulty. Sometimes the best treatment includes extraction of some teeth and grinding of others. This depends on the conditions and circumstances of the case.

Posterior Teeth.—When the deformity is caused by the third molars, and the first and second molars are present, I usually extract the interfering third molars, as this is both speedy and effective. In cases where the first molar is missing, if the drawing forward of the second molars would cause them to incline forward too much, I sometimes find it proper even then to remove these third molars, especially when the fault appears to lie in an abnormal shape of one or both jawbones. When these teeth are extracted, the others fall back soon if not immediately into their proper relation with the upper.

Whenever the cause of anterior displacement of the lower jaw is found in the tilting forward of the second lower molars where the first molars from some cause have been lost, so that the tilting of these teeth causes the plane of the posterior cusps to rise as the tooth tilts forward toward the

[1] For further consideration of the question of differential diagnosis of this, with other forms of displacement, the reader is referred to the second chapter following.

space left by the missing tooth, the interfering cusps may be ground as previously suggested, but sometimes a better plan is to right-up the tilted tooth or teeth. To do this is not always easy, but in most cases it can be done successfully by one of two plans ; first by the agency of a screw or sometimes by a spring anchored to an anchor-plate fitted accurately to all the lower teeth ; second by an independent lever fixed to each tilted tooth, substantially as suggested by Dr. George S. Allan. As a small plate will not in all cases afford sufficient anchorage to prevent the anterior teeth from being moved out of place, nor a large plate always

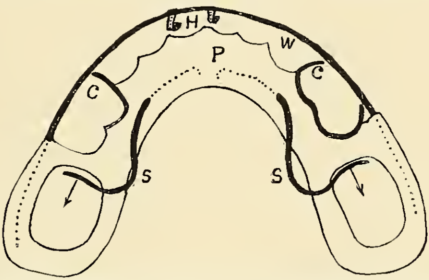


Fig. 566.—Plate for righting up Lower Molars. P, Hard rubber plate; C, C, Clasps; S, S, Springs to right up the inclined teeth; W, Long-band; H, Hooks. (Allan.)

be a guarantee against it, one of the other plans may be preferable. Dr. Allan informs me that he once tried to right-up two such second molars by the use of a plate and spring made as illustrated by Fig. 566, and failing of success he succeeded by using the devices shown in Fig. 567.

When this device (566) was placed in position "it seemed to be acting successfully, because it was worn with comfort, and was easily managed, but the anchorage proved unstable, and the device forced the lower anterior teeth forward nearly as rapidly as the tilted molars moved back ; but, when this was dispensed with and replaced by the lever devices" shown in Fig. 567 "there was no further difficulty in righting up the teeth."[1]

In detail, this latter device consists of a stiff ferule made so as to fit around the tilted molar, and had three ears made of plate, which projected downward from the ferule so as to hold the tooth still more firmly. Projecting posteriorly from the upper margin of the ferule is a piece of stiff plate L which serves as a lever to the ferule; and which, when bitten upon, tends to "right-up" the tooth. When ready for action, this device is cemented to the tilted tooth by phosphate of zinc. In the case mentioned the teeth were

FIG. 567.—Levered Rings for Righting up Tilted Lower Molars (Allan).[2]

righted-up, so that the lower jaw fell back into place in about "six months." After having heard of this device, I suggested as an improvement that if, instead of anchoring the lever L to a tooth-ring, a thimble-crown made large enough to enclose the entire crown of the tooth would, when cemented in place, be a firmer anchorage ; and that if a piece of stiff wire were soldered to the buccal side of the thimble so as to project forward past the first bicuspid, but lying closely to it, to serve as a retainer to hold the tooth in position, at the close of the operation, by bending it so as to rest against the posterior surface of the bicuspid, it would be an additional improvement. Of course, the lever should then be cut away from the thimble-crown. As a permanent retaining device, some dentists recommend a partial denture, having an artificial tooth between the righted-up tooth and the one anterior to it. I generally use a cantilever crown.[3]

[1] Drawn from the original. [2] "Devised in September, 1885."
[3] See Cantilever Crowns as Retainers, Part VII.

CHAPTER LV.

ANTERIOR DISPLACEMENT OF THE LOWER JAW, FROM WANT OF ANTAGONISM OF SIDE TEETH.

MAL-OCCLUSION OF THE ANTERIOR TEETH.—TREATMENT.

IN the cases now to be treated, the lower anterior teeth (either from wear or loss of the side teeth or from a habit of projecting the lower jaw forward too far for the lower side teeth to antagonize) slide in front of the upper in such a manner and with so much force that they not only push each other in opposite directions, but also sometimes

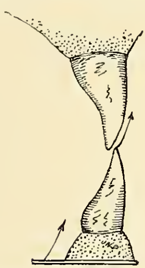


FIG. 568.— Initiatory Scissors Antagonism.

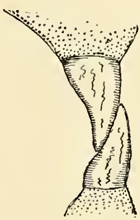


FIG. 569.—Scissors Antagonism Completed.

chafe the posterior surfaces of the lower and the anterior of the upper, so frequently as to wear them, causing the edges of the upper and lower front teeth to become quite sharp.

Fig. 568 indicates by arrows the arc of the lower jaw and the peculiar scissors-like antagonism just about to take place by passing the cutting edge of the upper teeth, and Fig. 569 the appearance of the jaws at full occlusion.

Whether any benefit can be brought about by grinding, and to what degree antagonism is attainable, depends entirely upon the relative position of the lower teeth to that of the upper. If the lower anterior teeth project greatly beyond the upper teeth there is nothing to be gained by grinding unless they are forced back; but, if the position of the lower teeth is not far from normal, and the upper have been forced by them into a posterior position, the scissors-like antagonism being close and firm, even if there is considerable overlap, there is reason to expect benefit from grinding. But again the extent of area, that the ground ends of these teeth respectively can be made to cover varies widely in different cases, and in different teeth in the same case; this depending upon the shape of the line of arc made in the play of the lower jaw, and the relative position of one tooth to another. If the line of arc is as shown in Fig. 568, and the teeth impinge tightly like shears, and appear to have forced each other from their former positions, the grinding away of one-fourth or one-third of the length of the crowns, leaving the ends square, will immediately enable the latter in many cases to antagonize usefully to a greater or less degree, and will undergo further improvement, in the course of a year or two, for reasons to be given further on. The area of the ends of the teeth that can be covered by antagonism after grinding is generally less than one-half of their planes. This may not be regarded by some people to be a great gain, but to those who have no side teeth with which to masticate, even this degree of increase of useful surface, I think, is a great advantage, and a decided improvement over the scissors-like antagonism. Even if it only serves as a resting-place for the jaw, the operation is worth performing; but, as will soon be shown, it generally furnishes greater benefit.

In no instance in my practice have I been able at first to make the opposing teeth cover more than half the area of the ground surfaces, but by bevelling the ends, so as to cause a tendency on the part of the teeth to slide on each other as upon an inclined plane, a greater extent of the surface can be covered. Even if there is no bevel, those teeth which have been driven out of place by the occlusion will sometimes move back and greatly improve the antagonism.

Case I.—To illustrate these principles, let us take a sec-

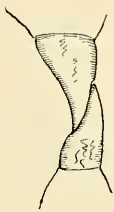


FIG. 570.—Scissors Antagonism before being Operated upon.

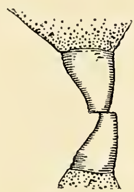


FIG. 571.—Scissors Antagonism after being Operated upon.

tional view of a case as shown in Fig. 570, showing the original condition of the antagonism in a case where the side teeth were lost. This figure illustrates the case after these teeth had become considerably worn by many years of friction upon each other. The opportunity for obtaining antagonism in this case was of the average degree. Careful study of the closing of the jaws showed that the scissors-like antagonism had, by the teeth sliding upon each other, evidently forced the lower ones forward, and the upper backward about an eighth of an inch. The diagnosis also showed that if the sharp ends of the teeth were ground off, leaving a flat surface, this forward movement of the lower jaw might be averted. The extent to which these teeth could be ground without causing pain, however, would, of course, determine the degree of success. A trial showed that the grinding caused no pain, even when carried to the degree necessary for securing considerable benefit, and the operation was performed at one sitting. The result is shown in Fig. 571. The patient was then enabled to masticate food better than at any time since he lost his side teeth. After the lapse of a year, upon discovering that the antagonism was but little improved, the teeth were ground shorter on one side so as to bevel them slightly as shown correctly in the upper tooth, and in excess in the lower (Fig.

FIG. 572.—Teeth ground so that they Antagonize on inclined Surfaces.

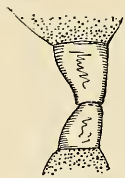


FIG. 573.—Section view showing how to arrest the Movement of Teeth.

572[1]). This caused them to antagonize on inclined planes, so that the upper teeth tended to move anteriorly and the lower teeth posteriorly, as before explained. When teeth are thus moved into place, and there is any liability of their going too far by continuing to slide upon the inclined surfaces, they should again be ground or built up with gold; the lower ones being made slightly crowning, and the upper with a corresponding hollow or concave surface, so that the ends will lock together, and retain each other in place, as in Fig. 573.

Case II.—Fig. 574 illustrates the antagonism of a similar case before being operated upon, and Fig. 575 the appear-

[1] Excess by error in engraving.

ance of the same case at the completion of the operation. This patient, who was a man about forty years old, had preserved several of his side teeth of the upper jaw, but had lost all the corresponding teeth of the lower, leaving only the cuspids and incisors to antagonize, all of which (lower teeth) upon occlusion of the jaws, passed in front of the

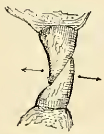


FIG. 574.—Side Section before the Operation.

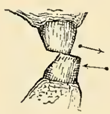


FIG. 575.—Same View after the Operation.

upper teeth in scissors fashion as shown in Fig. 574, thus rendering mastication of food impossible.

Desiring to avoid resorting to the use of an artificial denture, but with no great faith in being able to bring about complete antagonism, I tried this operation and ground the teeth to the degree shown in Fig. 575, and in course of time the operation proved highly successful.

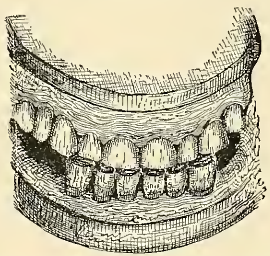


FIG. 576.—Appearance of the case of Scissors-antagonism immediately after the Operation by Grinding.

Fig. 576 is a front view of this case at the close of thirty minutes' grinding. Having brought about antagonism, varying from one-third to one-half of the ends of the teeth, they were left nearly square across, in order to ascertain whether the antagonism would improve by the teeth moving of themselves; but finding after several weeks that their relation did not change rapidly enough, the ends of the teeth were reground a trifle more, yet sufficiently to increase considerably the inclination of the surfaces, (more than in Fig. 575). I then dismissed the patient, and took no further note of the matter, until five years later, when, by comparing the teeth with the casts I had taken, they were found to have undergone great changes in their relative positions.

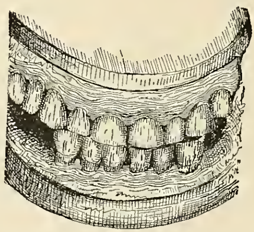


FIG. 577.—Appearance of the case five years after the Operation.

Fig. 577 is a front view of the teeth at this time. All the teeth at the right of the median line had moved so that their labial surfaces were even with each other, but those on the left had not made so much progress. Still, it was sufficient to make them nearly as useful as those of the opposite side. The comparative degree of movement of teeth of the opposite jaws I am not able to state, but that the upper teeth moved forward more than the lower moved back, there is no doubt. I regard this case, taking the age into consideration, as important for showing the value of this operation.[1]

[1] Bond case, Author's Dental Register (large series), Vol. III.

Philosophy of the Operation for correcting Scissors-antagonism.—As the upper teeth are relatively stationary with the bones of the cranium, while the lower teeth move about with the lower jaw, it will be seen that, in grinding the upper teeth, care should be taken not to sacrifice more of their substance than is necessary to secure a proper surface on which to bite. If the cutting ends should normally project anteriorly, as shown in Fig. 578, the anterior margin of these ends, after being ground, would be posterior to the original position; or, in other words, the antagonizing surfaces would be farther back. This is illustrated by contrast with cases having normally receding teeth, as shown in Fig.

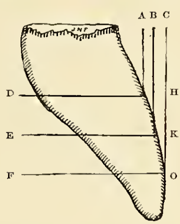


Fig. 578.—Protruding Incisor.

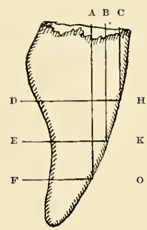


Fig. 579.—Receding Incisor.

579. The engravings, however, represent a degree of inclination greater than normal, so drawn in order to make the point clear.

The relative position of the perpendicular lines in these two figures, A H, B K, C O, show the opposite effect that grinding from the cutting edges up to either of the corresponding parallel lines, F O, E K, D H, would cause; that, while grinding to the line F O, in Fig. 578, would not materially change the position of the anterior margin of the plane of antagonism, in grinding to the line E K or D H, the posterior transference of the plane would correspond to the distance between the lines C B and B A. On the other hand, as shown in Fig. 579, it will be seen that, as the cutting edge of the incisor does not project forward, as in Fig. 578, but inclines backward, this tooth, if ground, would carry the antagonizing surface plane forward instead of backward, to an extent corresponding to the distance between the lines A B and B C. In making the diagnosis of such a case, as is shown in Fig. 579, however, it should be taken into consideration whether this position has been caused by scissors-antagonism; if so, and if the tooth should move forward after it had been liberated from the scissors-antagonism, the prognosis would be still more favorable.

There is another point which has already been referred to which, if not taken into consideration in diagnosis, may render the process of grinding useless, namely, the relative natural position of the upper and lower teeth; for, if the lower teeth always protruded beyond the upper, grinding would avail nothing. Usually, when the jaws are far apart and the head is upright, the cutting ends of the lower incisors will be found to be posterior to a perpendicular line let fall from the cutting edges of the upper teeth; but, as the jaws close, the lower teeth not only swing upward but also forward on an arc that places protruding lower teeth in advance of the cutting edges of the upper teeth before they are brought in contact, so that the edges of the upper teeth would strike, if they struck at all, at the base of the lingual portion of the crowns of the lower teeth. Another point that should be regarded in the diagnosis is the fact that the grinding of only one arch will not aid the occlusion; that is to say, if the upper teeth should be ground, and the lower not at all, as shown in Fig. 580, the question of how much antagonism could be attained by grinding the lower arch would still be as far from a solution as in the first place.

This would also be the case if the grinding should be confined to the lower tooth, as shown in Fig. 581, unless there should be a tendency of the lower jaw to fall back immediately after the scissors-inclined antagonism is removed, as fortunately there generally is, at least in some

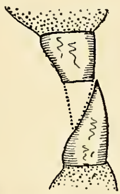


FIG. 580.—Showing the effect of Grinding only the Upper.

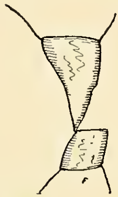


FIG. 581.—Showing the effect of Grinding only the Lower.

measure. The edge of the unground tooth, instead of resting outside of the border of the plane of the tooth ground, would then rest within. To gain the greatest degree of improvement, it is better to grind both the upper and lower teeth at the same time, first one, then the other, feeling the way carefully, bearing in mind, also, that, if the lower teeth project, the more they are ground the greater

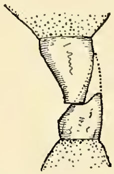


FIG. 582.—Increasing the area of Antagonism by Grinding the Lower Tooth more than the Upper.

are the chances of increasing the surface of antagonism. To enable the tooth to appear longer, the anterior wall may be left longer than the posterior portion, if it does not interfere with the upper tooth. This is shown in Fig. 582.

To reiterate: as the prognosis of this operation can only be determined approximately by careful study of the opening and closing of the jaws, noticing the extent of the forward motion of the lower teeth (on account of the scissors-antagonism), every step should be taken with caution; grinding, gradually, until the greatest degree of possible improvement is attained.

Long-standing Cases.—The following chapter is devoted to a class of cases of protruding lower jaws that are not amenable to treatment, but there is a class of protracted cases of displacement of the condyle, which, because of their being of too long standing, are not capable of self-correction by improving the antagonism simply, but by applying force artificially to the chin, the deformity can in time be corrected. Whether, however, it is always prudent to attempt it, is another question. One device used for such cases is the "occipito-mental sling," as made by Fox and described by Harris, 1850, and another by Garretson ("Oral Surgery," 1881, p. 122). The chin parts are bound on by straps over the top of the head. A later modification by Dr. Allan, sometimes preferred, consists of a cap made of leather or of strong netting, sewed to a strong band of woven fabric encircling the head just above the ears, to which are attached four straps, each having a hook or buckle, two extending down in front of the ears and two behind them to connect with a chin-cap made of sheet metal, leather, pasteboard, or papier maché, and padded to prevent irritation of the skin. Two of these straps pull in such a way as to draw the lower jaw almost directly backward. In Part XIX., Vol. 2, these devices, as applied in practice, will be found explained.

CHAPTER LVI.

POSTERIOR DISPLACEMENT OF THE LOWER JAW.

DIFFERENTIAL DIAGNOSIS OF THE VARIOUS ABNORMAL CONDITIONS.—CASES.

HAVING considered one form of lateral displacement of the lower jaw, and also its anterior displacement, there now remains to be investigated a class of cases which, although not common, are sufficiently numerous to be entitled to notice. These are cases where the lower jaw occludes too far posterior to the normal position, which, by contrast, gives the upper teeth the appearance of protruding. Not to include congenital cases, where the lower jaw appears to recede because too short, this condition is caused by the cusps of the opposing teeth locking in the wrong place, so that the lower teeth, biting upon slightly inclined surfaces, slide back, causing the mobile lower jaw to move posteriorly, thus presenting the appearance of a receding chin. Nor is this all: the pressure of the lower cuspids and bicuspids upon the posterior walls of the upper teeth, sometimes tends to drive them (the upper ones) forward, thus, by the double and opposite movement, causing in time a greater deformity.

If these teeth are liberated by grinding away the interfering cusps or by moving some of the interfering teeth (usually the upper cuspids) out of the way, the lower jaw immediately moves forward of itself, thus partially or wholly correcting the deformity.

Case.—As an illustration of this process I will mention the case of a girl about thirteen years of age, whom I treated in 1886. Having made no casts, and having lost sight of the patient, I will confine myself to a brief general description.

The deformity consisted in the apparent protrusion of the upper teeth, together with a recession of the lower jaw; it was corrected to a remarkable degree by the removal of interfering cusps by grinding, in consequence of which the lower jaw immediately moved forward. Not only did the chin assume a normal relation to the other parts of the face, but the upper anterior teeth ceased to appear protruding. The complete correction was thus attained with very little effort and without the aid of regulating apparatus.

Occasionally this relation of the jaws is brought about in cases having narrow and V-shaped upper arches, in conjunction with long anterior lower teeth and short side teeth, so that, in mastication, the lower incisors, by sliding on the lingual wall of the upper incisors, and impinging on the gums behind them, sometimes indent them before the side teeth have erupted sufficiently to antagonize ; hence, either for mastication or to avoid pain, the lower jaw is held back so long that some of the side teeth finally fall into the wrong lock. If this abnormal antagonism has become habitual before the eruption of the cuspids, it will be evident that the growing down of these (cuspid) teeth posterior to their proper places, even if only to a slight degree, may fix the occlusion of the jaws in the wrong place, so that even if in time the antagonism of the lower teeth should so impinge upon the upper cuspids as to move them forward, it will have the effect of causing a jumbled condition by driving the upper laterals forward so as to overlap the centrals.

Treatment.—Whether the deformity in these cases arises, as described, from a single or complex cause, the shortening of long lower incisors by grinding, so that they will not interfere with the teeth or cause pain in the gums of the upper jaw, and the grinding away of a sufficient amount of the interfering cusps of the cuspids and side teeth of either jaw, or moving the interfering teeth out of each other's way, usually attainable by widening the arch, especially the cuspid region, will effect the liberation of the lower jaw, which will immediately be followed by a forward movement of the chin, thus also partially or wholly removing the appearance of protruding upper teeth. This statement refers principally to young people, before the articular cartilages and ligaments have become firmly fixed in their altered dimensions, and before abnormal habits of the masticatory muscles are established; for it would not always be found correct in later life when these tissues have become fully developed and fixed.[1]

Thus it will be seen that grinding teeth or widening the arch will not only assist in carrying forward a receding chin, but will sometimes also simplify some operations for correcting (really) protruding upper teeth. In addition to what has been recommended for the correction of this class of deformities, thimble-crowns placed upon the first molar teeth or prominent wart-plugs with proper surfaces to bite upon, placed in large cavities in the grinding surfaces of molar teeth, will not only prevent the locking, but will sometimes materially aid the "elongation" of the bicuspids.

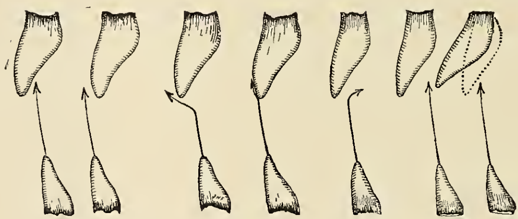
A plate made to cover the lower molars, having a raised surface on its upper side for the upper cusps to strike upon, will have the same effect in causing the rising of the bicuspids. But such plates are clumsy, and unless kept free from deposits of food will injure the lower teeth. In

[1] For an explanation of the process of correcting protruding front teeth, the reader is referred to Part XIX., Vol. 2.

view of this danger, and, as the use of plates that cover the crowns is unnecessary, I think such devices should be dispensed with.

DIFFERENTIAL DIAGNOSIS OF THE SEVERAL ABNORMAL RELATIONS OF THE JAWS.

As an aid to the definite understanding of the subject of the differential diagnosis of the various conditions and relations of the jaws, the reader is referred to the accompanying diagrams. Fig. 583 illustrates the line of arc made by the play of the lower jaw in cases where the relation of



583. 584. 585. 586. 587. 588. 589.

Different Lines of Arc made by Lower Jaws.

Fig. 583.—Normal relation of the Upper and Lower Jaws.

Fig. 584.—Protruding Lower Jaw abnormally too long either because of wrong shape of the Jawbone or from excessive looseness of the joint.

Fig. 585.—Anterior displacement from wrong antagonism of the Side Teeth.

Fig. 586.—Anterior displacement from scissors-antagonism of the Front Teeth.

Fig. 587.—Posterior displacement from wrong antagonism of the Side Teeth.

Fig. 588.—Apparent posterior position of a Lower Jaw that is normally too short.

Fig. 589.—Apparent posterior position of the Lower Jaw, occasioned by protruding Upper Teeth.

the two jaws is normal. Fig. 584 shows the line of arc that is made when the cause lies in the too great length or the malformation of the body of the lower jawbone, or, as pointed out by Dr. Tomes, when the angle of the ramus fails to undergo the normal degree of obliquity from the nearly straight line with the body of the jaw as found in childhood. This is also true in some cases where the glenoid cavities are too shallow or too large, so that the parts constituting the joint tissues are loose, or otherwise abnormal in conditions or arrangement. Fig. 585 shows the arc made when the protrusion of the lower jaw is caused by the sliding forward of the lower teeth upon the upper side teeth. Fig. 586, the line made when the protrusion of the lower jaw is caused by scissors-antagonism. Fig. 587, the line made when the antagonism of the side teeth is such as to cause, by sliding upon their inclined surfaces, posterior displacement of the lower jaw. Fig. 588, the line of arc of cases in which the lower jaw is abnormally small, and is not long enough for the anterior portion to reach to its proper place. Fig. 589, the line made by the apparent posterior abnormality caused by protrusion of the upper teeth, from the position of the dotted lines.

Physiological Deformities.—Regarding deformities from too short or too long jaw-bones (either the body or the ramus, or both), the matter of abnormal growth as a cause should receive more than a passing notice, for the short jaw may be caused by tardiness or total arrest of its growth; and the too prominent jaw may result from excessive or too long-continued growth, and both may be regarded as being physiological causes.

All physiologists know that the greater portion of the growth of the jaw (whether it be the upper or the lower), is in its posterior division; that while the arc of the alveolar ridge increases in early childhood by flaring outward, this growth is not often sufficient to cause the teeth to separate after five or six years of age; and that the territory for the adult molars is furnished by additional growth backward from a line drawn transversely across the arch just behind the deciduous set.

As to the lower jawbone, it is well-known that in infancy the body and ramus are nearly on a straight line, but soon afterward begin to change in shape, the ramus turning upward, as it were, and forming an angle on its upper border. This angle is first located just behind the place where the second deciduous molar will erupt in due time ; but as the child increases in age, the locality of this angle is found to be farther back ; this change of location is caused by the posterior movement of the ramus, leaving the body of the jawbone elongated, correspondingly. If these changes occur normally, the ramus will move back, and the posterior portion of the body (of the jawbone) will elongate sufficiently by the time the child is six years of age to make ample space (between the ramus and the second deciduous molar) for the first adult molar to erupt, and four or five years after (about eleven) sufficient to furnish room for the second molar, and six or seven years later (about eighteen) to permit the coming forth of the third molar, making in all an addition to the body, between the second bicuspid and ramus from an inch and a quarter to an inch and a half.

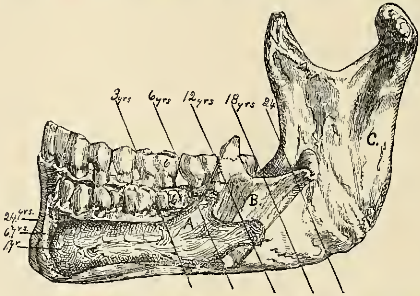


FIG. 590.—Lower Jaws, illustrating Changes between One, Six, and Twenty-four Years of Age.

In Fig. 590, which illustrates by A, B, C, the lower jaw at the ages of one year, six, and twenty-four, these differences in the shape and size of the jaws are relatively shown.

In this figure the divisions of the body of the bone, before referred to, are bounded by lines ; the figures above indicate the ages between which the portions of new bone, in the different periods of time, were formed.

It is claimed that, from experiments on the lower animals (by depositing metallic plugs in holes bored in the ramus), it has been proved that the change in the shape of the lower jawbone is not wholly brought about by the growth of the body, but by the wasting away of the anterior border of the ramus and the backward growth or addition of bone to the posterior border. While these elongating changes in the body are in progress, the ramus is lengthening from the condyle downward, and together with the body of the bone grows broader (deeper) and thicker. At the same time, the ramus continues to turn upward, more and more, until finally, in adult life, it is often found to be nearly or quite at right angles with the body. The portion of the jaw called the alveolar process also increases in height, all of which, together with the larger size of the teeth, causes the greater length of the face at maturity than in childhood.

During these changes, while the ramus is moving back, the relation of the condyle (in glenoid cavity) to the bones of the cranium may be said to remain comparatively stationary. This being the case, it will be seen that if there were no compensating changes taking place elsewhere to meet this growth, the anterior portion of nearly all lower jaws would become too prominent; see Fig. 591, the case of a man of middle age and of strong intelligence. One of the greatest of the compensating changes in the alteration, above mentioned, is the degree of the angle between the ramus and the body, from a straight line with the latter, as found in infancy, to a position at, or nearly at, right angles with it, as found in adult life.

In other words, as the body elongates backward, it pushes, as it were, the lower end of the ramus back without materially altering the position of the condyle, a change in the relation of the two parts, such as would be made by resting the forearm in a somewhat extended position on the table, making an obtuse angle at the joint, and then moving the elbow back so that the angle becomes a right angle, without moving the shoulder-joint. Another compensating change, though less in degree, is a slight growth of the anterior portion of the body of the upper jawbone, and the more extended growth and flaring outward of the alveolar process in early childhood (see p. 91 in this Vol.). Now if, instead of the changes in the two jaws being exact in their compensatory features, there should be unequal growth of the parts, it will be seen that there would be more or less deformity and want of co-adaptation of the jaws, and antagonism of teeth would be imperfect; the tardiness or total arrest of growth of the body of the lower jaw would cause it to be too short, as shown in Fig. 592 (which illustrates the case of a rather weak-minded woman about forty years of age[1]), and excessive growth would cause it to protrude, a result which in appearance would be the same as if the ramus should fail to assume the proper degree of angle with the body, as mentioned by Mr. Tomes, or should grow too long, as shown in Fig. 591.

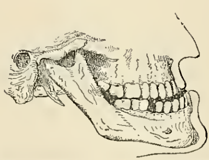


FIG. 591.—Excessive Growth of the Ramus.

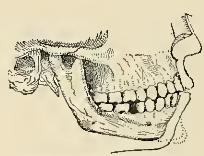


FIG. 592.—Receding Chin.

[1] These figures, and the preceding, like all figures drawn from life, can only show approximate accuracy.

Neither the early developement of the too-long jaw, nor the slow forward growth of chin portion, Fig. 593 (drawn

FIG. 593.—Protruding Chin.

from a specimen in the author's collection) which occasionally continues into adult life (transmitted in family lines),

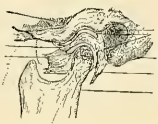


FIG. 594.—Condyle partially Dislocated, showing the inter-articular tissues about the Glenoid Cavity.

should be regarded as belonging to the class of cases mentioned as displacement of the lower jaw; and therefore cannot be said to be amenable to judicious treatment, by the occipito-mental apparatus. The former in slight degree, may sometimes be obliterated by compressing the inter-articular tissues over the condyle or even the condyle itself, see Fig. 594, but the correction cannot with any certainty be relied on as permanent. Of course, I do not pretend to say that the jaw cannot be modified in its form by persistent application of force for a great length of time, say two and three years or more, by some form of the Fox chin-harness, but an operation requiring such a protracted period to carry out, can not to be called prudent.

The cases that have been reported as exceptions and which have been corrected, I am inclined to believe, were not physiological in their nature, but belonged to the class mentioned in the last part of the preceding chapter, as permanent displacement of the condyle, which, as above mentioned, only required the reduction of the altered soft inter-articular tissues (by pressure) in order to restore the condyle to its former and proper position in the glenoid cavity.

Does the loss (in youth) of molar teeth of the lower jaw so far affect the growth of the jawbone as to arrest it, and thereby cause a shortening or inequality of the sides?—What all the causes are, which produce the too long or the too short lower jaw, we do not yet clearly understand; but that they are often, if not generally, inherited or, at least, are prenatal seems evident. It is, however, asserted by some persons that "the proper length of the body of the jawbone depends entirely upon the presence of all the teeth, and especially the molars"; that "the too short body of bone may be caused by loss of some of the adult molars"; that, "if the first or the second molars are extracted at an age when they are posterior teeth, the jaw will not grow to its proper length or to the length that it would grow if these teeth were not extracted," because the third molars would then move forward. In other words, the hypothesis is that, if the molars are not all present, there will not be sufficient influence to cause the ramus to move far enough back to make the body of the jaw long enough to place the anterior teeth sufficiently forward to be in normal relation with those of the upper jaw.

That the presence of all these teeth does, in a slight degree, influence the growth of the jawbone (as affirmed) is probable, but that such influences affect its growth to any material extent or to that degree which will visibly lengthen the jawbone, or that loss of the first molars can visibly shorten it (unless repeated through several generations), may be regarded as doubtful; because the jawbone, like all of the other bones of the body, generally follows a law of type. If teeth are necessary to the growth of the jawbones, what causes them to grow to the normal size in people who never have any teeth? A considerable number of such cases are on record.

Of course, short jawbones are often found; but to assert that these are the result of loss of the first or second molars seems to be an assumption without sufficient basis. Short jawbones are sometimes found to contain (in normal positions) the full number of these teeth. A case of this class recently came under my observation. Further than this, if the presence of all the molars will cause the ramus of the jaw to move back, and thus make room for themselves to erupt, why are there so many third lower molars imprisoned within the jawbone at the junction of the body and ramus? Again, if the influence of molar teeth is so great that it causes the jawbone to lengthen, and the loss of molars arrests the posterior growth of the bone, ought we not to expect that one side of the lower jaw which has been deprived of the molars early would be shorter than the opposite side, where no teeth have been lost; and, consequently, that such jaws would be found occluding sidewise, or else that the condyle of the shorter side would be drawn forward in the glenoid cavity by force of the antagonism?

While cases of lateral occlusion are often found, resulting from malformation of the jawbones (and by the lower jaw sliding sidewise upon interfering cusps of teeth), I think it is doubtful if any case can be proved to have its origin in a malformation caused by loss of molar teeth; since a large majority of jaws which occlude laterally have their complement of teeth. Such deductions, therefore, concerning the effects of the presence or the absence of molar teeth, should not be confounded with those which have reference to unequal lengths of the sides of the lower jawbone from prenatal causes or by disease, as mentioned in a footnote on page 557 of this volume. As correct diagnosis largely depends upon thorough knowledge of these various conditions, the subject ought not to be too lightly regarded.

Lateral displacement of the lower jaw, caused by abnormal position of the glenoid cavity.—In connection with this remark on variation in the two sides of the lower jawbone, together with the subject of displacement of the lower jaw (not dislocation), caused by improper antagonism, as explained in Chapter LIII., p. 554,[1] there is one more phase of importance, which should always be taken into consideration when making diagnosis; although (except in the question of diagnosis) it has nothing to do with variation in length of the two sides of the bone, above mentioned. I refer to the abnormal position of the glenoid cavity, which results from abnormal position of the temporal bone, causing the glenoid cavity to be posterior to its proper place, and differing in position from that of the opposite side. This difference is sometimes sufficient to cause a degree of lateral displacement (of the lower jaw) quite as great, and occasionally greater, than that which results from malantagonism of the teeth, or a difference in the lengths of the two sides of the bone.

These cases are somewhat difficult to diagnosticate, but they can generally be distinguished from the others by the sum total of variations in form and action of the jaw, and especially by noting a comparative difference in the direction of motion of the front lower teeth, and the same in regard to the positions of the ears (one ear being not only further back, but perhaps higher or lower than its fellow). For clearness of explanation let us compare, by the aid of the four diagrams which follow, these normal and abnormal positions, as found in practice. I shall, for brevity, confine the explanation principally to lateral displacement in one direction.

---

[1] Chapter LIII. embraces the subject of lateral displacement of the lower jaw from malantagonism of the teeth, and also suggests methods of treatment.

In Fig. 595, D shows a *left* lateral displacement of the lower jaw, caused by the *moving forward* of the *right condyle.*[1]

In Fig. 595*a*, S illustrates a *right* lateral displacement, resulting from the *right side* of the jawbone being *too short;* the left side being normal.

In Fig. 595*b*, A shows a *left* lateral displacement, caused by the *right side* of the jawbone being *too long;* the left side being normal.

In Fig. 595*c*, C illustrates a *left* lateral displacement, caused by the *left glenoid cavity* being located *posterior* to its proper place; the right cavity being normal.

Suppose two cases of left displacement of the lower jawbone: one caused by unequal lengths of the two sides where (for illustration) the right side is too long, as shown by A in Fig. 595*b*, and the other case of displacement to result from the left glenoid cavity being further back than the corresponding cavity on the opposite side of the head, as shown by C in Fig. 595*c*.

The features upon which a differential diagnosis between these different conditions depends, *i. e.*, the lateral displacement of the lower jaw from unequal length of the two sides of the bone, and a lateral displacement from abnormal positions of the glenoid cavities, vary, of course, somewhat, in different cases, according to the degree of abnormality of one or both. However, the main features of differentiation, although at first they may appear difficult to understand, will be found, after careful attention, not to be so. In the normal and proper conditions, the relation and position of the condyles of the lower jaw and the glenoid cavities, it will be

[1] In all the four figures the position of the line M corresponds with the median line of the nose, and the line L the middle of the displaced lower jaw.

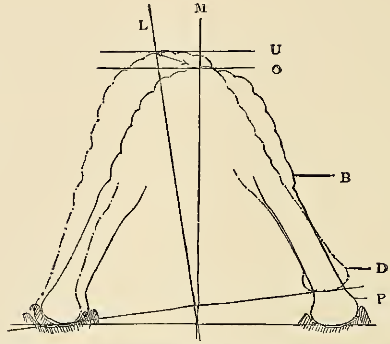


FIG. 595.—Left Lateral Displacement of Lower Jaw (B) caused by a forward movement of the Right Condyle (P to D). M corresponds, in all the figures, with the median line of the nose. (L) the Symphysis of the displaced jaw.

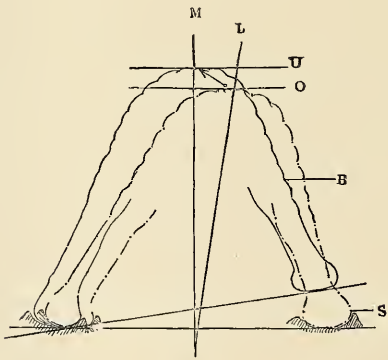


FIG. 595 a.—Right Lateral Displacement of Lower Jaw from the Right Side of the Bone being too Short.

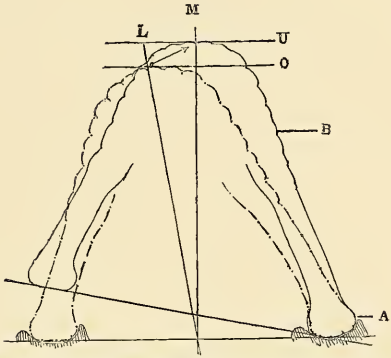


FIG. 595 b.—Left Lateral Displacement of Lower Jaw caused by the Right Side (A) of the Bone being too Long.

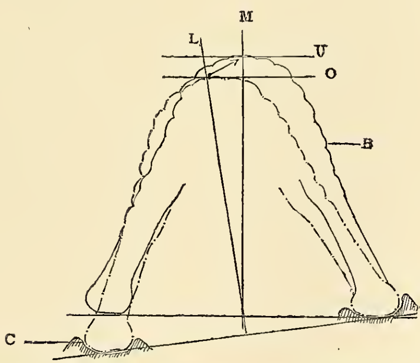


FIG. 595 c.—Left Lateral Displacement of Lower Jaw caused by the Left Glenoid Cavity (C) being Posterior to its Proper Position.

seen that the mouth in opening and closing on a vertical line does so by the condyles playing within close quarters, somewhat like a fixed hinge in the glenoid cavities; but, when by action of the muscles (connected with the jaw) a lateral motion of the jaw is made, the condyle (opposite to the direction of displacement) glides slightly forward from its normal position of rest to a strained position (though the condyle may be said to remain within the cavity). If, however, the condyle is moved further away from its place of rest it becomes dislocated, and the teeth, instead of remaining in contact, are wide apart; the mouth is open. The normal change of position of the front teeth and the right condyle (at P D,) from will power, is ideally shown in Fig. 595.

When a left lateral displacement of the jaw is taking place from easy muscular action, the front teeth always advance diagonally from the line O to the line U, and when the (right) condyle is brought back to its proper position in the glenoid cavity, the front teeth move in the reverse direction and to the right, *i. e.*, diagonally backward, as indicated by an arrow. In this respect the movement of the front teeth is in the reverse direction from that taken in correcting a right lateral displacement caused by one side of the jaw being too short or too long. One opposite course is shown by an arrow in Fig. 595*a*.

When a lateral displacement is occasioned by unequal lengths of the two sides of the jawbone, whether one side is too short or too long, neither condyle is moved out of place, but both remain in their proper positions in the glenoid cavities, and the jaw plays up and down on a line approximating perpendicular; the point between the central incisors, however, will be to one side of the median line, M, of the upper jaw. So, likewise, do the condyles of those jaws which are displaced laterally by malposition of the glenoid cavity, remain in their normal relations to the glenoid cavities, when the mouth is opened or closed. Therefore, in this respect, the behavior of the condyles of both of these classes of jaws is similar. So also is the relative action of the front teeth similar; and both differ from the behavior of those of normal cases, the middle point of the jaws of which play up and down on the median line, or laterally, when strained to the line L, as shown in Fig. 595.

Of course, as before briefly mentioned, the side of the jaw that is nearest to the proper length may be the longer side, or it may be the shorter, and in diagnosis this should be one of the first questions to determine. If the shorter side of the jaw is the normal one, as assumed in Fig. 595*b*, and the jaw should be moved to the right so that the median line (between the central incisors) would correspond with that of the upper jaw, it would be found that instead of the right condyle A moving backward, as in the case of the strained but normal condition (shown in Fig. 595), it would remain comparatively stationary in its proper place while the left condyle would move forward from its glenoid home. By this act there would be, however, a marked difference in the direction of motion of the front teeth, of the two classes of lower jaws, that will aid in making differential diagnosis. If a jaw, having its left side too short, is moved far enough to the right for the centrals to be on the median line with those of the upper jaw, it (the lower jaw) would play upon the right condyle as a stationary hinge, and thus draw the left condyle forward from its home in the glenoid cavity to a distance corresponding with its deficiency in length. This moving of the condyle forward would also move teeth diagonally forward, instead of diagonally backward, as shown in Fig. 595, in cases caused by malantagonism.

Whether in such cases this forward motion would or would not cause the teeth to *protrude* depends somewhat upon the anterior half of the lower jaw being of normal size or too short. If the lower teeth are greatly "under-set" from a receding chin portion of the jaw, although properly located (relatively speaking) in the jaw, and if the right side of the jawbone is otherwise of proper length, they would advance in the direction that is indicated by an arrow in Fig. 595*b*, but not so far forward, and might antagonize quite as well as in normal cases. If, on the contrary, the size of the anterior half of the jaw is normal, and the lower front teeth are set in normal relation to it, the moving forward of the condyle would cause protrusion of both teeth and chin. So, also, the teeth of a lower jaw, in a case where the left glenoid cavity is abnormally backward, if the jaw should be moved to the right (swinging on the right condyle as it were on a stationary hinge) so that the symphysis of the chin would be on the median line, they (the front lower teeth), if they are not abnormally "under-set," would (instead of being normally placed) protrude beyond the esthetic position. I have seen teeth, in some cases of this class, protrude as far as one-fourth of an inch beyond the upper teeth. Thus we can see that the behavior of the case of malposition of the glenoid cavity on the left side is similar to that of the jaw where the right arm is too long. To reiterate, in brief, the action of the front lower teeth in moving them to the median line, in cases of reduction of condyles strained forward, is always diagonally backward, while the action of the lower front teeth (in moving them to the median line), in all cases of unequal lengths of the sides of the lower jaw, is diagonally forward.

The important point in the diagnosis, however, as before referred to, is the examination and measurement of the head to ascertain the relative positions of the ears. A knowledge of the anatomy of the head, together with these other variations which have been noted, generally affords correct judgment.

There can be only partial correction of such cases, and that, too, mainly, by optical illusion, leaving the jaw in its natural position. It may be necessary, if the jaw is crooked, to extract or grind one or more of the posterior teeth to improve the antagonism. It may also be advisable to slightly move some of the bicuspids or the front teeth to approximate a balancing effect (esthetically) in the facial expression; but, if the patient be of the male sex, hiding the deformity caused by the lateral displacement of the jaw with a full beard is generally sufficient for esthetic effect, and it is always a safe treatment.

I can imagine, however, there might be cases of V-shaped or "saddle"-shaped arches in which the lines (of teeth) could be so changed in form as to greatly improve personal appearance; but, if there really are such cases, it would be difficult to even suggest any rule of action touching their treatment, further than being guided by circumstances and the conditions of each case.

CHAPTER LVII.

NON-OCCLUSION OF THE ANTERIOR TEETH.

CORRECTION BY GRINDING.—CASES.

THE conformation of the bones and the relation of the jaws are occasionally such as to prevent antagonism of the anterior teeth, thus leaving a space between them ; the same effect may also be caused by too great length of the posterior teeth. When the rami are too short, or the teeth are too long, so that those which are anterior do not antagonize, the necessary effort to close the lips causes a weakened expression of the face. These cases, too, when the jaws are examined independently while the mouth is open, sometimes appear normal when they are not. The drawn expression may also be caused by the lips being too short to be closed easily over long front teeth, though they antagonize. (On this phase of the subject, see figures showing the unbalancing of faces by artificial teeth, Part XXI., Vol. 2.)

Mention will be made in another chapter of extracting interfering back teeth as a means of correcting the deformity caused by their too early antagonism. Although this treatment is sometimes advisable, especially when the interfering teeth are badly decayed, there are instances in which it would not be as judicious as shortening these teeth by grinding.

The difficulty, if treated at an early age, may possibly be successfully corrected by the patient wearing a skull-cap and jaw-harness to draw upon the middle of the lower jaw to raise it to the upper, by causing a depression of the interfering teeth, or by pressure of the condyle causing some change in the anatomical relation of the parts in and about the glenoid cavity; or by bending the jawbone, or all combined. These operations, however, should never be tried without due consideration, because of their doubtful success; and besides their tediousness and inconvenience, the results, even if satisfactory at the time, have not been always permanent.

As stated in some previous chapters, there are dentists who will not advise grinding for fear of causing sensitiveness. Safety from this inconvenience depends mainly upon knowledge of the anatomy of the teeth and the proper method of grinding. It is better to do all that any given tooth requires or can tolerate at one sitting, as a second grinding at an early subsequent date is often painful. After one operation it is not often practicable to repeat it for several months, or possibly a year. This is not intended to convey the idea that it is necessary to grind at one sitting all the teeth that need such treatment. Although there are people to whom the harsh sounds occasioned by the grinding process are almost intolerable, yet most people can endure a great deal, if it is carefully done ; a little at a time, and with brief intermissions for rest. So far as the prejudice against grinding antagonizing surfaces, through fear of causing decay, is concerned, the notion has no foundation, nor will permanent sensitiveness result, if the grinding be judiciously performed. I have never seen a case where this has resulted, but I have heard it stated by dentists that such injury has been caused in their practice. In the cases that I have examined, I have found that the patients often mistook the position of the pain. Sometimes the pain has been traced to the necks of the teeth that have become sensitive from absorption of the gums and sockets; sometimes it was due to loculosis alveolaris or pocket disease of the sockets, and was not caused at all by the grinding. Every dentist of experience knows that patients cannot always accurately determine or point out the place where pain is felt, and often point to a tooth at some distance from the one about which the pain is really located. A striking illustration of this came to my notice not long ago. A gentleman of middle age had occasion to go to a prominent dentist to see what could be done to prevent the interference of a lower incisor which had permanently risen about an eighth of an inch from the socket. The difficulty was removed by cutting off the tooth so as to make it even with its neighbors; but soon after this operation the patient experienced sensitiveness from cold drinks, and the dentist, as is too often the case, became the subject of abuse by the patient and his family. The case was sent to me, and, on examination, it was proved to the patient that the grinding had no relation whatever to the pain; that it was confined solely to the exposed necks of the teeth adjacent, not to that which had been ground shorter, and that the occurrence of pain immediately after the grinding process was a mere coincidence. Referring the reader to the chapters in the latter portion of Part XIV., for the correction of such cases as require the extraction of the interfering posterior molars, we will now proceed to the consideration of those which are best treated by grinding.

The degree to which it is necessary to grind posterior teeth in order to enable the front teeth to occlude properly depends on two conditions: 1st, the width of the space between the front teeth; 2nd, the location and position in the dental arch of the interfering teeth. The distance from the condyle of the lower jaw to the cutting edges of the central incisors of the average adult is about four inches; now, from this articulation of the condyle and glenoid cavity, which somewhat resembles a ball-and-socket hinge, the movement of the lower jaw compared with the position of the upper is somewhat similar to the movement of one leg of a mechanic's divider to the other, the distance between the teeth having a relation to their distance from the joint,—that is to say, as the third molar stands about midway between the condyle and the central incisors, the distance between the upper and lower third molars of a normal case will be less than the distance between the front teeth. This measurement, it is true, varies slightly in different people, but the average distance between these molars, when the jaws are slightly separated, is about one-half the distance measured between the front teeth. To explain more fully: if the front teeth of normal jaws stand an inch apart, the distance between the third molars will be about one-half of an inch. Thus, when the posterior teeth occlude and leave the anterior teeth standing apart one-fourth of an inch, the shortening of these posterior teeth to make the anterior teeth occlude would be about one-eighth of an inch; or, in other words, each opposing molar would need to be ground one-sixteenth of an inch. In some cases, the whole of the ground portion may be better taken from the teeth of one jaw only; but, as a rule, it is better to divide and apply the grinding to both the upper and lower teeth.

Case I.—As an illustration of the reduction of gaping jaws by grinding, may be mentioned a case in practice; that of a gentleman about thirty years of age, of powerful build, having large strong teeth with but a few cavities (which were filled with gold). The ends of the crowns of the anterior teeth stood on planes rather less than one-fourth of an inch apart (see Fig. 596). Instead of extraction, the patient was advised to have the posterior teeth ground immediately as far as was prudent, and if the desired object should not be fully attained, to suspend further grinding for several months or a year, after which the operation

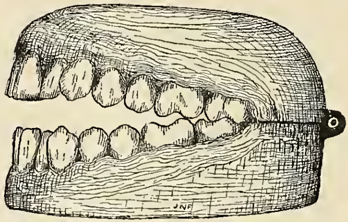


FIG. 596.—General Occlusion prevented by the Posterior Molars.

should be repeated at intervals until the teeth would occlude properly.

The molar teeth were ground nearly to the point of slight sensitiveness, when the deformity was about half corrected; the case was then suspended for about a year, when the grinding process was repeated and carried on, until the antagonism of the side teeth was nearly as desired; but it was regarded as prudent to defer completion of the operation

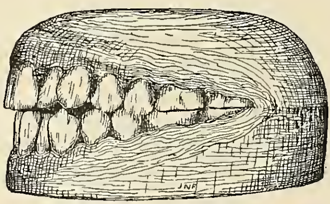


FIG. 597.—Gaping jaws after completion of Operation.

for another year. It was then resumed, and the case satisfactorily completed (see Fig. 597). To make the bicuspids antagonize properly, some of their cusps were also ground so as to have them lock better between each other, and others were made flat. When the teeth of the two jaws were made to close upon the proper plane, the upper anterior teeth projected beyond the lower slightly more than normal; but this was not noticeable. Several years have passed since this case was completed, and the patient states that he has never experienced any annoyance whatever from the grinding process.

Case II.—Occasionally, though rarely, the anterior teeth are prevented from occluding by the interference of bicuspids instead of the molars. Fig. 598 illustrates a case

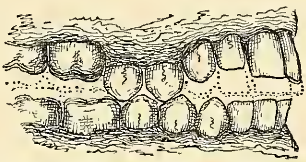


FIG. 598.—General Occlusion prevented by the Bicuspids.

of this description with an excessive alveolar growth. The patient had been taken from office to office, and from city to city, for advice. To quote her mother's words: "Sometimes the advice was to let the case alone; no one advised depression of these teeth, and no one mentioned grinding. Several advised extraction and the substitution of artificial teeth." I examined the case, and was convinced that grinding the teeth shorter was in every way the best treatment. I ground the teeth at the first sitting so that the molars occluded, and although I removed more than an eighth of an inch of tooth tissue from the upper and lower biscuspids combined, the patient did not experience pain, and I was informed several months later by her parents that no inconvenience resulted from the grinding, and that they regarded it as a marked improvement. The dotted lines show the relative change in the position of the teeth of the two jaws, brought about by grinding, and the completion after one year of the eruption of the upper and lower incisors. The remaining teeth were fully erupted at the time of grinding.

I would not have it understood that I advocate in all cases the amount of grinding at one sitting that I performed in this instance. It is better, especially for inexperienced operators, to proceed cautiously until practice has taught them the maximum degree to which grinding can be prudently carried.

PART XIII.

Interdental Spaces.

CHAPTER LVIII.

INTERDENTAL SPACES.—THEIR CAUSES.

SPACES FROM STRAGGLING.—EXCESS OF GROWTH OF JAW-BONE.—INTERSUTURAL DEPOSIT.—PERVERTED TISSUE ACTION.—MALANTAGONISM.—LATERAL MOTION OF THE LOWER JAW.—LOSS OF TEETH.

BEFORE entering upon the treatment of those classes of irregularities in which the question of extraction must be more or less considered, attention is called to the class in the treatment of which extraction plays no part; a class of defects denominated Interdental Spaces.

All human teeth slightly change their position by the force of antagonizing teeth, as, for instance, during mastication. When they are capable of returning, and do return, to their former position, after this force is suspended, these changes are said to be normal acts; but, if from any cause the teeth move a greater distance into improper positions, and permanently remain so changed, whether it be from antagonism or from any other force, the change is not regarded as normal. These abnormal positions of the teeth constitute what may be regarded as belonging to irregularities. In previous chapters other conditions of irregularity have been considered, especially that which is called "jumbled," which generally occurs from lack of room, but the cause of irregularity of this variety is quite the reverse. The abnormality is not caused by lack of room, nor are the teeth always on an irregular line, but they stand abnormally separated from each other.

In cases where there is more alveolar territory than is necessary for the teeth there must, of course, be more or less unoccupied space, and isolation of these members will be the consequence. Such excess of alveolar territory is often found almost equally divided, but there is a variety of defect in which the dental arch, though the teeth are otherwise well-arranged, is marred by the existence of one abnormally wide space, which, for instance, is often found between some of the incisors. Such defects are sometimes thought by patients to be irremediable, and therefore are allowed to remain unrectified for life, forming perhaps the only imperfection in beautiful faces.

Interdental spaces, whether they occur between the incisors or other teeth, are not all the result of the same kind of cause. They have been ascribed to various causes, and although, as a rule, these can be determined by examination, some of them are not as yet clearly understood.

Spaces Caused by Straggling of Teeth.—Interdental spaces are sometimes brought about by what is now com-

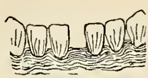


Fig. 599.—Crowns and Roots Misplaced.

Fig. 600.—Crowns Misplaced, the Apices of the Roots remaining in Normal Position.

monly designated "straggling,"[1] so called because they move independently of extraneous forces. Some of the teeth stand isolated, and others press hard against neighboring teeth. This straggling may occur before or after their complete development. The peculiarity in some of this class lies in the fact that they apparently stray without having been crowded or even from coming in contact with roots of adjacent teeth during the process of development. These straggling teeth may be subdivided into two classes. In the

[1] "Dental Cosmos," April, 1882, p. 86.

first the teeth stand erect, the apices of the roots as well as the crowns being misplaced (see Fig. 599); in the second the teeth incline; the crowns being more misplaced than the roots, as shown in Fig. 600.

As a general rule, the first class, or those straggling teeth, the crowns and roots of which are ont of place, become so during the eruptive process of their development, while the second class, or those which incline, do so in consequence

FIG. 601.—Interdental Space from Straggling of Centrals before Eruption of the Laterals.

of the falling away of the crowns from their former position after eruption. There are, however, cases (to which I shall again refer), in which the apices of the roots change their position long after the teeth have fully erupted, and even at a period late in life.

Both classes of displacement of the roots and crowns are frequently found in children who have prematurely lost two or more contiguous teeth, permitting thereby some of

FIG. 602.—Space caused by the Eruption of a Bicuspid in place of the Cuspid.

the second set to encroach upon territory belonging to their neighbors, occasioning unsightly spaces behind them, and more or less interfering with the eruptive process of successors beneath the gum, so that the latter are not only retarded in their development, but are sometimes guided astray.

Perhaps these phenomena of lateral movements of teeth from excess of room may become clearer by calling to mind cases where premature loss of all the deciduous upper incisors is followed by the encroachment of the adult centrals upon territory belonging to the adult laterals, as shown in Fig. 601, or those cases where the premature loss of the upper deciduous molars and adjacent deciduous cuspid is followed by the eruption of the first bicuspid in the place belonging to the adult cuspid (as shown in Fig. 602); or perhaps in the place of the second bicuspid (as shown in Case II. Part XIV.), thus interfering with the cuspid or second bicuspid; so that if this intruding adult tooth is not forced out of the way by art, the unerupted tooth is compelled to strive for its liberty as best it can; and if successful at all, the route is likely to lead it from the esthetic line.

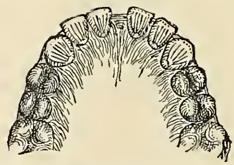


FIG. 603.—Interdental Spaces from Separation of the Halves of the Maxillary Bone, or from its Continued Growth.

While in some cases the cause of eruption of teeth in strange places is apparent, others are sometimes difficult to explain except in a hypothetical way. An explanation of the straying of teeth, and perhaps the best one, is that in the excess of alveolar territory, with no positive barrier such as

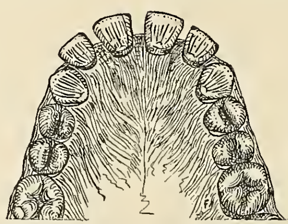


FIG. 604.—Interdental Spaces Caused by Mal-antagonism.

the presence of an adjacent tooth to guide the new one into its proper place, the new tooth in its comparative freedom of latitude is influenced to travel in the tissues along the line of the least resistance, thus differing from that in which the teeth stray or incline after full eruption.

Spaces from other Causes.—The cause of spaces found between teeth later in life is also sometimes difficult to point out. They may be the result of continued growth of the jawbones and alveolus (as shown in Fig. 603); separation of the halves of the maxillary bone.

It may, however, be the filling in between by interstitial growth of new tissues, disease or perversion of socket or dental tissue action, or oblique force on the teeth by antagonism (Fig. 604).

Spaces, caused by continued growth of all parts of the jaws, are comparatively rare. I have seen very few of them, and recall only a single case that might be alluded to as remarkable ; but spaces between the central incisors that seem to result from the moving apart of the halves of the maxilla are more numerous. This apparent frequency is, by no means, proof that such is the real reason.

Under the head of perverted tissue action may be mentioned ptyalism, *loculosis alveolaris*,[1] and exostosis of the roots of the teeth. Of such causes (except the last), little need be said, since it is obvious that where there is disease of the alveolus, there is softening and yielding of the tissue, leading to a sufficient enlargement of the sockets, to permit displacement of the teeth.

---

[1] An abbreviated term meaning what I denominate "Pocket Disease of the Alveolus," translated for the author by request.

Its etymology is as follows:

Loc (us) = a place.
(ul) = diminutive suffix.
Locul (us) = a little place, or hole; a fold in the "toga," used as a pocket.
os (is) = a Greek termination denoting the becoming, or the change to a certain state; as, necrosis, "becoming dead."
Loculosis = the formation of, or "becoming," a pocket; or a disease which consists in the formation of a pocket.
Alveolaris = pertaining to, or situated in, the alveolus.
Loculosis Alveolaris = pocket disease located in the alveolus. Pocket disease of the alveolus.

[See "Independent Practitioner," 1886, pp. 172–178.]

There is, however, a class of cases in which the movements, although similar, are not as yet fully explained. Such cases are those in which there is apparently no socket disease, and yet the teeth move to a considerable distance. One marked peculiarity of some of these cases is the fact that, on the rear side (opposite to the advancing side) of the moving tooth, there is a collection of salivary calculi, while on the opposite side there is little or none. (See Fig. 605.)

Fig. 605.—Interdental Space, with Deposits of Calculi.

This peculiarity, which every dentist has seen, and which, so far as I know, was first pointed out by Dr. Guilford, has been asserted to have its cause in loculosis alveolaris (at an early stage), not perceptible to the eye, and that the leaning of the tooth away from the side of the socket over which the calculi rest (on the tooth) is because of the weakening of the hold on that side of the tooth by the socket tissues, leaving the attachments of the healthy side so much stronger that they draw the tooth over. This hypothesis is regarded as exceedingly questionable. I have seen many cases of this kind which I feel confident were not in the least affected with loculosis. So far as I have examined such cases, I am led from observation to suspect (as pointed out by Dr. Dwinelle) that exostosis of the roots may be the cause, or that malantagonism is the principal if not sole influence in such derangements of the teeth; but both may be combined. Where a tooth does not stand so as to receive the force of antagonism of the opposite teeth (or, what is the same thing, the effect of trituration of the food) in a line with the long axis of the tooth, the obliquity of direction of the force upon a slightly inclined tooth may, and often does, push it over to one side. Even if teeth erupted properly, the lateral movement of the lower jaw in the act of masticating food would occasionally be sufficient to force some teeth to one side. This lateral force upon slightly inclined teeth, coupled with the increasing advantage of the power of perpendicular motions, as the inclination of the tooth increases (as under similar conditions with front teeth when the side teeth are lost) is sufficient (without any disease of the sockets) to cause spaces.

Spaces may be caused by "tilting over" toward the open places made by loss of some tooth or teeth. It is generally supposed that while teeth which are situated posteriorly to spaces made by loss of the first molar (especially of the lower jaw) usually move forward, those teeth which are anterior to such spaces do *not* move backward. Now, though we very often find posterior teeth moving forward, it is also a fact, if not so frequent, that teeth anterior to the spaces *do* move backward, and occasionally so far back that spaces are made in this way between some of them.

I have known several instances where the bicuspids and cuspids have moved backward to such a distance that these teeth, as well as the incisors, inclined to one side so much that they were unsightly, and regulating operations were necessary to correct the deformity.

Of course, everybody knows that spaces are made by extraction of teeth. Although not strictly belonging to the class of spaces generally referred to in the literature of our profession as "interdental," still, as the operations for closing such spaces are similar to those for closing other spaces, I regard it as proper to include them among the others in the matter of correction.

Having briefly surveyed the field of causes, we will now consider the different methods in practice for closing spaces; beginning, primarily, with operations necessary for the "righting-up" of inclining teeth, illustrated by office cases, and proceeding to operations by laterally moving both crown and root. But, prior to doing so, the question of propriety of moving teeth before the roots are fully developed will be discussed.

CHAPTER LIX.

ON THE MOVING OF TEETH TO CLOSE INTERDENTAL SPACES.

IS APPREHENSION OF INJURY FROM THE MOVEMENT OF TEETH BEFORE THEIR ROOTS ARE FULLY DEVELOPED WELL FOUNDED?

THERE are two reasons for moving straggling teeth to close interdental spaces: one is for the purpose of making room for teeth in process of development; the other is purely esthetic. If the object is merely to clear the path for adjacent unerupted teeth, it is well to examine the case carefully before attempting to use appliances; for, unless the erupted teeth encroach too much upon their territory, the stragglers will generally move out of the way as successors approach, *i. e.*, provided there is room on their opposite side.

As a rule, if these teeth do not encroach more than from one-thirty-second to one-sixteenth of an inch upon the path of others, interference is unnecessary. If the encroachment exceeds this distance, however, experience teaches that some auxiliary is generally needed in order to prevent the eruption of the later teeth anterior or posterior to the esthetic line; or to prevent a still more serious injury—their permanent arrest within the jaw. The necessity for such interference is in proportion to the increase of displacement in excess of the measurement just named.

In the case of rudimentary teeth, especially if abnormally small and feeble, a slight degree of interference by such superincumbent teeth will sometimes throw them out of their proper course, arrest their eruptive progress, or even change them from a normal to an abnormal or perhaps into perverted molecular development.

While the method of treatment may be practically the same for all variations of position, differences in the condition of the roots, and in the hardness of the alveolar process, and also the age of the patient, may considerably modify the extent of labor and affect the length of time necessary to insure success. A tooth with a short root is more easily moved than a tooth with a long root, and a tooth will move more easily before the roots are fully formed than after they are completed, because the shorter the calcified portion of the root, the less the alveolar resistance. Opinions differ, however, in regard to moving teeth before they are fully developed. Some dentists, for fear of causing deformity of the root, teach that "even if the lateral movement of roots is possible, it should never be attempted before complete calcification."

To question any accepted tradition is regarded as rash; but, in the progress of ideas, the heterodoxy of to-day often becomes the orthodoxy of to-morrow. This is a sufficient reason for criticising opinions that seem to me to be stumbling-blocks in the path of improvement.

The crown of a tooth forms and becomes calcified before the root is wholly formed, and, as it moves out of its first home, deep in the jaw, the root gradually develops and extends from it in a soft condition, which afterward becomes hard by calcification. The external portion changes first; the inner, last. Should the root become calcified, nearly or quite to the apex, even though some part of it be only a thin shell, this calcified part would not necessarily be bent in the careful effort to move the tooth; but as the direction of development of the future portion of the root lies along the course of the nutrient vessels to the crown, it is apparent that, if the root be calcified only one-half or one-third of its destined length, the part that subsequently develops, by remaining stationary while the calcified portion is being moved, would probably cause the tooth to be more or less deformed; the extent and degree of deformity depending upon the extent of the lack in the development referred to, and upon the distance that the calcified portion is moved.

The present object, therefore, is not so much to state these facts regarding the shape of roots as to inquire whether or not teeth should be regulated before they are completely developed, and to place the whole question (of force artificially applied to teeth for correction of irregularities) in such a light that the student will clearly understand the subject and will have full confidence in his own judgment.

FIG. 606.—Enamel Cap of a Molar.

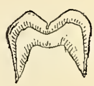


FIG. 607.—Crown of a Molar.

To repeat what has been said, and without going into histological details, the calcified portion of the crown, when it begins to move from its position within the jaw, is a shallow cap (see Fig. 606) with little or no evidence of anything to indicate the general shape which the tooth is afterward to assume; but, as development advances, there is added a ring-like formation, which lengthens, becomes tubular, and is lined with the earlier condition of dentine. (Fig. 607.)

At the time the tooth appears through the gum, the root is from one-third to one-half its normal length.

FIG. 608.—Third (upper) Molar as it appears at the time of Eruption.

Fig. 608 is a sectional view of an upper third molar at the period of its eruption, showing the average degree of development at this time.

Between the external tissues of the tooth, the enamel and cementum, and this sensitive tissue within (denominated dentine), there is what the earlier writers called a "granular stratum." From this granular line, the calcifying process extends in opposite directions, outward, toward the surface of the enamel and cementum, and, inward, toward the pulp. As already mentioned, the end of a partially developed root is in a soft, pulpy state, while the portion situated a little nearer the crown is harder, and in a cartilage-like condition; the older portion of this formation being found more and more calcified as the cervical portion of the tooth is approached.

If it were possible to extract all these portions of a tooth, both hard and soft, while in this stage of development, and subject them to maceration, divesting the calcified portion of all the softer parts, the tooth would appear considerably shorter, and would consist of a hollow crown, externally of normal appearance, with more or less of the external parts of the root extending from it, thicker at the cervical portion and becoming thinner as the apical extremity is approached. We are, however, at present interested in the behavior of the incompleted part of the tooth which is not calcified, together with any invisible portion, when the crown is subjected to the influence of mechanical force.

Every anatomist knows that abnormalities in the shape of roots occasionally occur in the natural process of dental development, yet the wonder is, when the jumbled (original) condition of the adult teeth before eruption is taken into consideration, that order ever evolves from such apparent confusion. (See Fig. 609.)

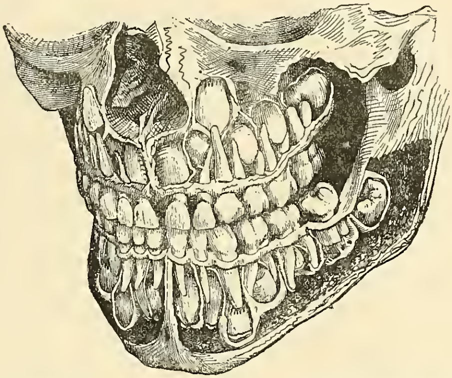


FIG. 609.—Internal view of the Human Jaw at the age of six-and-a-half years; showing the Relation of the Two Sets of Teeth.

A large majority of crowns are found in regular position in the arch, but how much of the evenness depends upon this irregularity of shape of the roots is an interesting question. We find that there are only a few cases in which some of the roots are not more or less distorted, showing that many regular arches are probably caused by a more or less lateral movement of the crowns, leaving the roots to develop along the track of the "nutrient cord."

The more this subject is studied, the more apparent becomes the importance of that wonderful law which causes the crowns to form and place themselves, leaving the roots for later development along this line of their nutrient supply, which may be straight or crooked as the case demands; strong evidence that natural law sometimes seeks esthetic results, in parts that are visible, at the expense of the regularity of parts that are invisible; that harmony and beauty in the natural formation of the visible portion of the arch do not always depend upon straight roots, but quite often upon their crookedness.

If distortion of the roots is found in nature to be necessary to the esthetic arrangement of the crowns, then any such change brought about by artificial appliances cannot be regarded as unscientific. In operations, the crookedness of fully developed roots sometimes (yet rarely) interferes with the perfect arrangement of the crowns, but this seldom occurs in earlier life, before the roots are developed. In "righting-up" the crown of an inclining tooth, the root of which is only two-thirds formed (a process which does not materially move the uncalcified portion of the root), the long axis of the calcified portion might be thrown out of the line of the long axis of the uncalcified portion, and thus cause a curvature; but, should the long axis of the different portions of the tooth be already crooked, the operation might straighten the tooth, provided the (original) curvature is in the right direction. One of these changes takes place in many, if not most teeth that incline *inward* or *outward* when regulated soon after their eruption. Yet, strange as it may appear, regulating operations upon teeth at this period are not regarded as detrimental by some who teach that "the *lateral* movement of crowns should never be attempted before complete development of the roots."

CHAPTER LX.

PHILOSOPHY OF LATERAL MOVEMENT OF CROWNS AND ROOTS OF TEETH TO CLOSE INTERDENTAL SPACES.

EFFECT OF THE OPERATION UPON UNCALCIFIED PORTIONS OF THE ROOTS ILLUSTRATED.

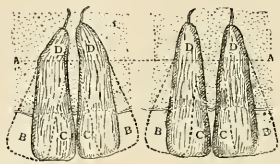
IT now remains for me to demonstrate the changes that really take place in the forms of teeth when regulated before complete development.

To illustrate the matter more clearly, teeth shall be considered in two situations and conditions: one in which the portions most misplaced are the crowns of the teeth, the other in which the crowns and roots are equally misplaced, a portion of the roots in both cases not being fully developed.

Leaving the consideration of the second condition for a later chapter, and beginning with the first condition named, attention is invited to the two following diagrams (610 and 611) which illustrate the lateral displacement of the crowns of two upper central incisors, before their complete development, showing also the effect of regulating apparatus on their shape.

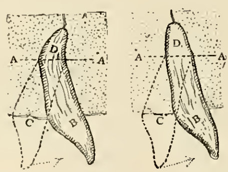
The dotted lines B B, B B, and the portions D D, D D, in these figures represent outlines of teeth differing in shape, between the crowns of which are the interdental spaces. The boundary between the calcified and uncalcified parts is indicated by the dotted line A A.

Fig. 610 shows (more distinctly than found in nature) the position of the apical portions, D D, to be in their proper relation to the position of their crowns, B B, but as the crowns incline out of their places and the apices of the roots are also correspondingly inclined out of *their* places, it will be seen that if the crowns are moved from



FIGS. 610, 611.—Effect of Tilting Movement of Crowns of Incisors before full development of the Apical Extremities of the Roots.[1]

the position of the dotted lines, B B, to the position C C, it would naturally cause a change in the form of the roots, because the portions, D D, being soft, would not move. On the other hand, the roots, D D, in Fig. 611 show the



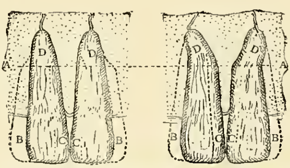
FIGS. 612, 613.—Illustration of the Effect of Anterior Movement of posteriorily inclined Crowns of Incisors before full development of the Root Extremities.

apical uncalcified portions in their proper positions in relation to the alveolus, but not in proper relations to the crowns when located as shown by dotted lines B B, a situation that might take place by the drifting apart of

[1] FIGS. 610–621, illustrating this subject, were first published by the author in the "Dental Cosmos," beginning June, 1882.

the crowns after eruption and before complete development of the roots. Therefore, by moving the crowns from the position B B, to the position C C (to do away with the interdental space) before the roots are fully formed and calcified, would straighten the roots.

Figs. 612 and 613 illustrate, in dotted lines, C C, conditions similar to those before mentioned, the only difference being that the crowns incline inwardly instead of laterally. The possible changes in moving upper incisors forward, before the complete development of their roots, are also shown. Here, also, as in the preceding figures, A A marks the dividing line between the calcified portions, C C, and the uncalcified, D D, and further shows the shape that teeth might in time assume if left undisturbed at C C; while the plain lines, B D, B D, show the shape that they would assume if the crowns, C C, should be forced forward into their proper positions.



FIGS. 614, 615.—Diagrams illustrating the Effect of the Lateral Movement of both Crowns and Roots before full development.

Lateral movement of both roots and crowns of teeth to close interdental spaces.—Having illustrated the effect on uncalcified portions of roots of inclining teeth by the "righting-up" of the crowns, let us now consider the effect of the lateral movement of the crowns and calcified portions of the roots of teeth upon the uncalcified, for the purpose of ascertaining if there is really any reason why such operations may not also be performed on this class of teeth (at any time) before their full development.

Figs. 614 and 615 represent, by similarly dotted and plain lines, as in Figs. 610–12, two different shapes and positions of upper incisors, showing, in the same way as the previous figures, the difference between the original shape and the possible change in form that might be caused by the lateral movement (to an equal distance) of all parts of the calcified portions of the roots. These two figures also show how the same kind of operation upon differently posed roots may effect quite a difference in the relative positions of the developed and the undeveloped portions, and further show that what is true of central incisors is probably true of other teeth.

Fig. 614 illustrates (below the dotted line, A A) the calcified portions, B B, of the teeth as they appear separated, and (above the line) the rudimentary portions, D D (here also shown more distinctly than found in nature), nearly in proper position; C C representing the calcified portions of the roots moved toward each other, and the crowns in contact, showing how such an operation may possibly straighten the teeth. But, in the case illustrated by Fig. 615, although the teeth *per se* are of proper form, the undeveloped apical portions are so far apart that the same kind of movement of the calcified portions, from B B to C C, would probably cause deformity of the roots. In either of these cases, it is evident that so far as the movement of the crowns to do away with interdental spaces is concerned, there cannot be any valid objection to the operation before the roots are completely developed.

Concerning the mutual influence of undeveloped, erupted, and non-erupted teeth upon each other.—Having thus considered the possible effect of the lateral movement of the calcified portions of teeth upon their uncalcified portions, let us now direct our attention to the effect of these cases upon unerupted teeth that are beneath them. As an illustration, the influence of erupted centrals and unerupted laterals upon each other will be shown.

Although it is true that in such cases (the completion of) the roots along the courses of the nutrient tracks might, and probably would, undergo slight deformity, yet it is difficult to conceive how such a deformity of the apical extremities, before calcification, could materially affect the development of these teeth, for the reason that generally the hard crowns of the laterals would have passed beyond the region of the undeveloped portions of the roots of the centrals. Even if it were not so, the hard crowns of the laterals would have sufficient advantage over the soft (uncalcified) portions of the roots of the centrals to push them aside, if need be; and do this, without injuring them.

Whatever the result of contact of calcified portions of the laterals with uncalcified portions of the centrals, I think that hard portions of interfering erupted teeth should be moved out of the way of others lying underneath, not only to prevent irregularity of the crowns, but also to prevent their calcified portions from being injured by pressure of each other. Sometimes this pressure causes defective enamel of the laterals, and a destructive influence upon the roots of the centrals, which is difficult to diagnosticate and impossible to correct, beyond such remedy as nature may in time provide, and this is not always perfect.

Although there have been cases in which neglecting to move interfering teeth out of the way of unerupted teeth has led to mischief, I have not as yet known any injury to arise from a timely operation. But, while I believe that the process of correction should begin at a time sufficiently early to prevent injury, it need not be so early as to necessitate a too protracted use of retaining devices. If, however, there is any doubt on this point, I think it advisable to begin too soon rather than too late.

But, in order to guard against any possible detriment, there should be some knowledge of the position and relation of the erupted and unerupted teeth to each other, before beginning to operate. For illustration, let us take a case in which the central incisors had straggled apart on account of premature loss of the deciduous laterals, which, according to the rule, erupt about a year later than the adult centrals. If the operation of drawing the centrals together be attempted a few weeks before the usual or expected time of eruption of the laterals, the crowns of the laterals will probably have passed the boundary line between the calcified and uncalcified portions of the roots of the centrals in their opposite progress. Therefore, the crowns of the laterals, if there be sufficient room made between the centrals and cuspids, would erupt in proper relation to these earlier teeth. Should deformity of any of these roots (centrals or laterals) take place under such circumstances, which, to a limited extent, is quite possible, it would cause no harm whatever, as in the subsequent development of their roots, the centrals and laterals would co-adapt themselves. Even if the crowns of the laterals should not have passed this uncalcified section of the centrals, they would not be deflected by their pulpiness; and whatever form the uncalcified portions of the roots of the centrals might chance to take, it would make very slight difference, if any, in the arrangement and position of the crowns of the lateral incisors; so that, under nearly all possible circumstances, the argument is in favor of early action, and strongly against delay.

If the matter of crookedness of the roots were important, there would be reason for constant apprehension of harm through operations for regulating teeth at any time in childhood, but the fact (with which every experienced regulator is familiar) that crookedness is seldom regarded in cases of young children, is an evidence that experience has taught dentists that there is little or no warrant for apprehension of injury. So, also, in later life, the easy correction of teeth (whose irregularity has been caused by the too protracted retention of some of the deciduous set), the roots of which would be found crooked if extracted, shows that this condition, *i. e.*, crookedness of roots, is not necessarily a preventive of success.

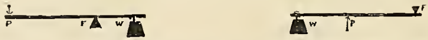
I have, it is true, in the course of my experience in dentistry, seen a few teeth so deformed that the curved roots prevented the crowns from being moved into proper positions without disturbing an adjacent tooth, but I have never seen an injury of this or any other kind caused through the correction of teeth before the roots were fully developed; which shows that, if there is any advantage to be derived from selection of age for such operations, it is in favor of the time when teeth are not fully developed. The philosophy of this kind of operation will now be explained.[1]

Philosophy of two plans of operations for lateral movements of roots and crowns of teeth, illustrated by forcing centrals together.— In simply moving the crowns of teeth, the apical extremities of the roots of which are already in proper position, the operation should always be based upon that principle of mechanics shown in Fig. 616, which places the fulcrum, F, between the point where the power, P P, is applied and that of the resistance or weight, W.

---

[1] Published by the author in the "Dental Cosmos," 1882, Vol. XXIV., p. 190.

But, on the contrary, for the lateral movement of roots, the power should be applied between the fulcrum, F, and the point of resistance or weight, W, as shown in Fig. 617. Before this philosophy can be utilized, it will be

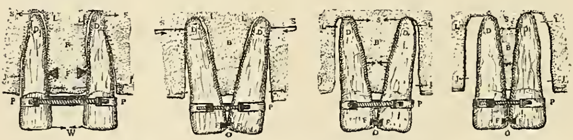


FIGS. 616, 617.—Illustrating the difference between the Philosophies of the Lateral Movements of Crowns and Roots.

necessary to sometimes apply the former kind as a preparatory step. This is the indirect plan.

As these appliances are as well adapted to teeth, the roots of which are partially developed, as to those whose roots are wholly formed, I will, to simplify the explanation of the philosophy, assume that the teeth are fully developed.

The four figures (618–621) illustrate successive stages in such an operation. The arrows show the direction of the movement of different portions of the teeth at different stages in the operation.



FIGS. 618, 619.—Philosophy of Leverage before and after Contact. FIG. 620.—Third Stage of Operation. FIG. 621.—Completed.

P represents a clamp-band; D D, roots; B, alveolus; F F F, places of fulcral bearings; S, direction the root is tending; J and L, places of separation between the roots and sockets, caused by the operation.

Fig. 618 illustrates two central incisors (D D) standing apart, showing the space between, and Fig. 619, by comparison, shows how the continued use of the same device, P (clamp-band), after the crowns are brought together, will act differently on the different parts of the teeth and their sockets, by the self-shifting of the fulcrum, F, from a point within the alveolus, B, to the point O, causing the dental leverage to act in the opposite direction.

Now, if the portion of the septum, B, Fig. 618, around F (which acts in some measure as a fulcrum), is so hard that it will not easily yield to pressure, and the alveolus about the apices of the roots is soft, a drawing force of the clamp-band, P, on the necks of the teeth would cause the apices of the roots, D D, to tend in the direction of S S, and opposite to that of the crowns, and also cause absorption of the alveolus at the points pressed upon, and separation of the root from the walls of the socket, at L L, opposite. (A pushing force applied between the crowns, such as from a wedge or screw-jack, would also cause the same act but in an opposite direction, making spaces on the sides, S S, of the apices of the roots.) It should, however, be remembered that in actual practice (with the clamp-band) the alveolus is not soft enough at first to yield easily at any of the points pressed upon; but, after the pressure has been maintained for a considerable length of time, the alveolar tissue undergoes more or less retrogressive morphological action (liquefaction and absorption[1]), the effect of which is reduction of the tissue at the points, S S (Fig. 618). But there is also going on absorption of that portion of the alveolus which constitutes the fulcrum, F (by pressure of the tooth upon it). For this reason the degree of inclination of the crowns of the teeth is reduced, so that their attitude after the crowns are in contact (Fig. 619) more nearly approximates parallelism than if only the portions of the alveolus about the apices of the roots were reduced. Under such circumstances, force, applied to unsustained crowns, sufficient to draw them toward each other, would, besides causing separation at L L, also make separation between the necks of the teeth and socket-

[1] See Note, p. 189, on Effect of Pressure ; Absorption.

walls at the points J J, which would, through this opposite play of the different arms of the dental lever, increase, as the case advanced, until the crowns were brought in contact. The first stage being completed, we enter on the next to bring about parallelism of the roots by causing the apical portions to approach each other. The shifting of the fulcrum F (in B), to O places the power (of the band P) between the fulcrum and resistance B, thus changing the direction of leverage. When the crowns are brought in contact at O (Fig. 619), and the automatical change in the position of the fulcrums, F F, takes place, the power from the same apparatus being continued, the apices of the roots stop their course in the direction of S S, and move in exactly the opposite direction, toward L L.

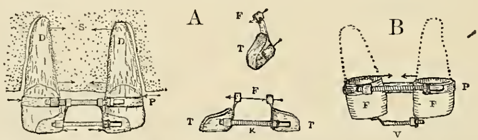


FIG. 622.—Closing Interdental Space by the Direct Operation, Two Mechanisms. (A.)

Figure 620 illustrates a later period in the operation, and shows the relative changes in position of the teeth, and also the changes in the shape of the sockets made by continuance of force upon the teeth. Fig. 621 illustrates the appearance at the close of the operation. As here exhibited, these figures should be regarded in a conventional sense, as, in fact, no spaces exist; for, as shown by Black, as fast as the teeth move from the socket-walls, the fibers of the pericemental membrane stretch, and are interstitially filled by the elements of new tissue.

As before said, this operation embraces two principles of mechanical philosophy. One is shown when the apices of the roots are moving further apart; the other, when they are nearing. Although apparatus for this indirect operation embraces both principles, the movement of roots toward each other can sometimes be accomplished solely by the second, a process which I denominate the direct operation. This process is best performed by an adjustable device added to the clamp-band so that it will, when placed between the ends of the crowns, prevent the rate of their movement being greater than that of the ends of the roots. Theoretically, an adjustable element of the mechanism might consist of an automatically sliding fulcrum, in principle, such as is used in many kinds of steel machinery of the shops; but the weakness of anchorage in such devices upon the short arms of the (dental) levers would render them unreliable. An adjustable element, with no such difficulty to overcome, is one that is adjustable at will. This may consist of interchangeable graduated blocks to place between the crowns (laid in the guide-trough), but a far more valuable adjustable element (because accurate in its movements) is a screw. In Fig. 622, A and B represent two such devices (gold); one (A) is shown as applied to teeth. This consists of a clamp-band, P, screw, K, and two hoods, T T. Each of these hoods is suspended on a gold ribbon from a loose ferule on the bolt of the clamp-band. The other device, B, consists of clamp-band, P, a screw, V, with a loose adjustable nut, and two thimble crowns, F F, the latter being cemented on the teeth. One end of the screw, V (filed thin), is soldered to one of the thimble crowns; the other end rests loosely in a hole through a lug soldered to the other thimble, as shown. In operating the mechanism, A, the adjusting screw and the clamp-band bolt are both turned, equally, at the same time. The mechanism, B, is operated by turning the nut (on its screw) the same distance that the clamp-band bolt is turned. By either mechanism the crowns and roots of the teeth move parallel to each other.[1]

[1] See Operations, page 647, Vol. I., also in Part XV., Vol. II.

CHAPTER LXI.

VARIOUS OPERATIONS FOR CLOSING INTER-DENTAL SPACES.

MOVING CROWNS ONLY.— MOVING BOTH CROWNS AND ROOTS.— IMPLANTATION.

WHETHER spaces are caused by abnormality in the development of the teeth or the jaws, or by some peculiarity in shape, size, or position of the teeth, or by the absence of teeth from extraction, is generally immaterial, so far as treatment is concerned, but the advisability of the operation may be governed by circumstances, the degree of disfigurement, age, and character of the constitution. The probability of permanence of success of such operations should also be regarded; for these defects may be comparatively easy to correct, and yet the retention of the teeth in the new positions be exceedingly difficult. Every dentist knows that when teeth are left isolated they are liable to move about from very slight causes, unless closely secured in position by some means; but upon this point more will be said later.

Interfering antagonism occurs, in greater or less degree, in nearly every individual at some period of life, and is so fruitful of harm that it should be one of the first points attended to, and prevented, when possible.[1]

Occasionally the lower front teeth are so prominent that when the jaws occlude they strike the lingual surfaces of

[1] See Part XII., On Grinding of Teeth.

the upper teeth with sufficient force to push them outward, and sometimes laterally in opposite directions, making spaces here and there along the line, generally wider at some points than at others, these being usually between the centrals.

When the defect is recent, its progress may be arrested, and (generally) its correction accomplished, by simply grinding away the interfering points; but when the defect is of long standing, grinding, alone, is not sufficient, and auxiliaries are necessary. If the space is in the middle of the jaw, one way is to draw the teeth toward the median line, but, to avoid causing noticeable spaces on the other side of the teeth, it may be best to divide the space so that the teeth will stand at about equal distances apart. Although this method may be applied with advantage to spaces of moderate width, very wide spaces may sometimes require one or more artificial substitutes to perfect the arch. Occasionally more or less turning and change of inclination of adjacent teeth, especially of the six front teeth, will greatly aid in closing spaces.

Esthetically speaking, however, the remedy for spaces at any age, where no tooth is missing, is the division of the superfluous room between several of the teeth, as before said, or by implantation of a tooth in the space; yet there are cases, in advanced life, in which the time and expense of these operations, the inconvenience to the patients, and possibly other circumstances might render it so troublesome that, in case of a very wide space, the choice would lie between its abnormal appearance or an artificial tooth. I have in several such cases (but not between centrals) adopted the latter method with satisfaction to the patient. This will be illustrated later.

To explain one method of remedying interdental spaces by moving the teeth, a case (illustrated by Fig. 623) is here given. The patient was a woman, about thirty-five years of age, whose upper centrals had erupted one-fourth of an inch apart, evidently in consequence of there never having been any laterals. Excepting the left cuspid, which stood in the anterior position, and needed drawing inwardly, all the teeth were on line.

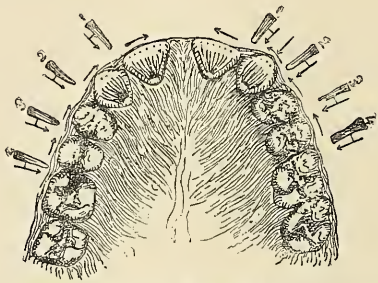


FIG. 623.—Appearance of a Case of Interdental Space before being closed by the Use of Wooden Wedges.

To fill the central space, two plans suggested themselves: First, To move the cuspids and bicuspids as far back as possible, force the centrals together, and interpose two artificial laterals; Second, To move all the eight anterior teeth forward. Esthetically regarded, the plan of interposing artificial laterals was the better one; but the patient preferred the latter. She was requested to call at the office once a week, but she and her husband were instructed how to accomplish the correcting mainly by their own efforts at home, by means of wooden wedges of different sizes, forced between the teeth, and renewed daily until the eight teeth were forced forward sufficiently to close the inter-incisor space.

The details of the operation were as follows: The centrals were first driven together by wedges placed between them and the cuspids, and then temporarily bound together until the cuspids were brought up to them by other wedges interposed between these cuspids and the first bicuspids. The binding on the centrals was then removed, and a gold band (sufficiently large to enclose the cuspids) was applied as a retainer. The first bicuspids were then brought forward in the same manner and tied to the last-mentioned band with fine linen strings, which held them there until the second bicuspids were moved forward against the first bicuspids by wedges forced between them and the first molars. These eight teeth were then temporarily retained in place by a hard-rubber roof-plate, with projections which filled the new spaces between the second bicuspids and molars, caused by moving the eight teeth forward. This plate was further secured in place by clasps, which fitted around the second bicuspids, all of which served also as anchorage for a gold wire which projected between the left second bicuspid and first molar, and extended forward to bear upon the outstanding left cuspid, and forced it into line by repeatedly bending the wire inward.

After the cuspid had been brought into line, the hard-rubber roof-plate was removed, and a more delicate device substituted, which served for permanent use. This detachable device, as applied to the teeth, is shown in Fig. 624.

It was made of half-round gold wire, extending along near the lingual surface of the teeth, and held in place by small clasps on the second bicuspids. On the posterior arm of each bicuspid clasp, a prominence or bulb (not clearly shown in the figure) was made, by solder, to fill the spaces between the second bicuspids and molars, and to prevent the eight forward teeth from moving back. The cuspid, as shown, was held in place by fingers projecting from the

U-wire base, and hooked a short distance around the labial curvatures of the tooth. The patient has worn this device for six years, and, having become accustomed to it, prefers to continue wearing it rather than risk the teeth again becoming displaced. As the spaces anterior to the molars were caused by the other teeth advancing, and as the molars had an effective antagonism, it was not thought best to move the latter forward. In time, however, when it will be prudent to file away the promi-

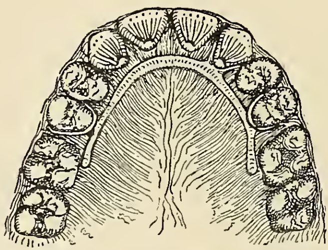


FIG. 624.—Appearance of Case at Completion of Operation.

nences on the rear clasps (but not remove them), I expect to find that these spaces will close by the anterior movement of the molars. This is often practicable in such cases, not, however, as frequently at the age of this patient as in earlier life.

If the reader has not heretofore seen the force of the remark that the interposition of artificial laterals between the centrals and cuspids was the better plan, it must now become apparent, since the same device which is used at present as a retainer would have given support to the artificial laterals without increasing the inconvenience of the patient. Though willing to tolerate the gold-retaining device, the patient "could not endure the idea of wearing artificial teeth," even if they would remove the coarseness of expression which loss of the laterals always causes.[1]

To illustrate other and different plans, we will now describe the operations for correcting a few typical cases, in which the age of the patients varied from fifteen to forty-five years.

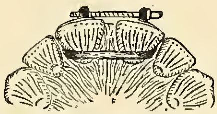


FIG. 625.— Interdental Space closed by a Clamp-band.

Fig. 625 illustrates the case of an interdental space in a girl about fifteen years of age. The arrangement of her teeth was otherwise nearly perfect. As to the cause, it was found upon examination that when the jaws occluded the front lower teeth struck the upper teeth upon their posterior surfaces at points a little behind their cutting edges in such a manner as to force the latter forward and to the right and left, causing a single opening between the central incisors, nearly an eighth of an inch wide. There was a redundancy of gum tissue in this space which added greatly to the annoyance of the patient.

A reduction of the lower arch (so that the lower incisors would stand further inward, and thus permit the upper arch to be sufficiently reduced in size to close the space) was not deemed advisable. The treatment adopted was a division of the gum territory occupied by the four incisors, by moving the centrals toward the median line, so as to make the four incisors stand apart, equidistantly. The first effort to accomplish this end was made by the

[1] For further details on this point of esthetics see chapter on Cuspid vs. Lateral, in Part on Extraction.

use of a gold, screw clamp-band placed around the centrals (shown in the figure), which drew them together. After the centrals had begun to move they were followed for a short distance by the natural movement of the laterals. When the centrals had been drawn into contact, they were held there by the same band for several days, and until the redundancy of interdental gum tissue had, by pressure, become reduced. The band was then removed, and the incisors held in place for some time by phosphate of zinc interposed between the teeth. This cement was kept in its place by being anchored in approximal cavities caused by decay. When the tenderness of the sockets acted upon had so far passed away that the teeth could be malleted, gold plugs were inserted in the cavities, and so shaped that they came in contact with each other in the same manner as the convex surfaces of two oranges would. The appearance of the case at this time is shown in Fig. 626.

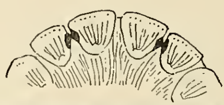


FIG. 626.—Teeth retained by Gold wart-shaped Plugs.

One object in holding the two centrals in contact, for a few days previous to the placing of these plugs, was to weaken the tendency of the sockets to separate the teeth when liberated, and also to secure as much room as possible for the easy insertion of the wart-shaped fillings. Although teeth in such cases as these may be held in contact for a considerable time (three or four weeks), their disposition to return to their former places upon the removal of the regulating device is usually so strong as to cause, even then, a narrow space. In this instance advantage was taken of this fact to hold the centrals in contact while the wart-shaped fillings were inserted and finished off so as to bear upon each other. The figure shows the appearance of the case two months afterward, and at the time when the space desired was expected to have reached its maximum.

When there are no cavities, teeth may generally be held in place by light detachable retaining devices, as shown in Fig. 627, but the drawback, in cases where teeth cannot be held in contact by means of wart-shaped fillings, is that they are liable to go astray upon the removal of the device; but the patients who attach much importance to personal appearance will not insist upon this removal, preferring to continue the use of the retainer, rather than show a disfigurement.

Case II.—A singular adverse experience (where wart-plugs were relied upon too early) was in a case apparently similar to the preceding one — that of a young lady, of about the same age (fifteen). The case was corrected by the same treatment, but about two weeks after the wart-shaped fillings had been inserted, I was surprised to find that the operation, instead of doing away with the single space, had caused three, one in the former place between the centrals and two between these teeth and the laterals, each of which, at first glance, seemed as large as the original space. The middle one was brought about by the reaction of the centrals, while the others, although no larger than when the wart-shaped fillings were inserted, had reacted (with their fillings) so as to move the cuspids, showing also a disposition to slide around in front of them.

Finding that the result from using wart-shaped fillings was not permanent, these fillings were filed flush with the surface of the teeth, after which the clamp-band was reapplied, and the centrals again drawn nearly together and allowed to remain until the laterals had returned, when an impression of the upper teeth was taken, and a detachable retaining device, made of half-round wire, was inserted. (See Fig. 627.)

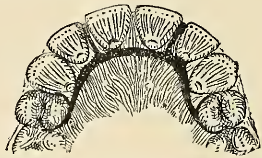


FIG. 627.—Incisors Held in Place by a Detachable Skeleton Device. (A.)

In such cases I generally use retainers for about one year, and longer, if the reactive tendency of the teeth is not thoroughly broken, after which the wart-shaped plugs are inserted, to take the place of the fingers of the device. In this case the use of the detachable retaining device was found to be necessary for two years before the plugs were re-inserted.

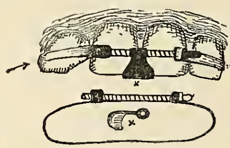


FIG. 628.—Interdental Space between a Central and Lateral Closed by a Clamp-Band, Aided by a Guide-Trough.
An Edge View of the Device in Parts. (A.)

Case III.—Fig. 628 shows the case of a woman about twenty-two years of age, who, in girlhood, lost her right upper (deciduous) cuspid, which permitted the lateral to tilt obliquely over upon its territory, causing a space between the lateral and central, and leaving another space (one-eighth of an inch wide) between the lateral and the first bicuspid, all of which caused a striking disfigurement. To "right-up" the lateral so as to stand in its proper place alongside the central would not make quite room enough to interpose an artificial cuspid of the proper size, and to move the bicuspids forward to fill the space left by the cuspid (which would have been practicable) was a more troublesome operation than the patient was willing to undergo, so that I reluctantly decided to do away with the space between the central and lateral, and also the inclination of the lateral, by "righting-up" the latter, using a clamp-band, applied as shown in Fig. 628.

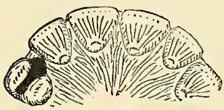


FIG. 629.—Lateral Incisor Retained by a Wart-Plug.

To hold the central incisors in place and prevent them from overlapping when tightened upon by the clamp-band, which drew the lateral to place, a guide-trough was attached as shown in the figure. The construction of this guide-trough will be more clearly explained in the next chapter. (See Fig. 645.)

After the teeth were corrected, an old amalgam filling (which was found in a cavity in the anterior approximal surface of the right bicuspid) was removed, and a large gold wart-shaped plug was inserted. (See Fig. 629.) This simple operation, although satisfactory to the patient, was not as acceptable to me as would have been the moving of the bicuspid forward, leaving the space further back.

Case IV.—Having described the treatment of interdental spaces between upper incisors, attention is now called to those between lower incisors, after which, spaces in other places in the dental arch will be considered.

A lady, about thirty years of age, noticed that her lower incisors had begun to drift apart, and that they continued to do so until the space was about one-eighth of an inch in width. At the time I first saw the patient the laterals stood partially in front of the cuspids. Whether this lap existed before the appearance of the opening between the centrals could not be positively ascertained, but the appearance indicated that the overlapping was comparatively recent, and that both the space and the overlapping

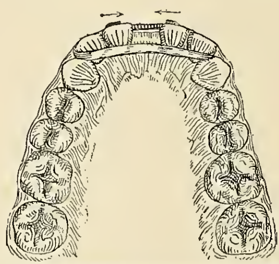


FIG. 630.—Closing an Interdental Space between Lower Incisors.—First Stage.

may have been caused by either the front or the side teeth bearing upon each other in an oblique direction. The points on the front teeth that antagonized hard on each other were sufficiently ground away to escape contact, but those of the side teeth were not disturbed. This grinding being completed, a delicate gold clamp-band was placed around the four incisors, so that the screw rested off against the labial side, as illustrated in Fig. 630. The patient was then instructed to turn the screw night and morning, and to report progress in a day or two. In three days (I unexpectedly found) the space was closed. In order to lessen, in some degree, the tendency of the teeth to return, the gold band was not removed until about two weeks later.

Fig. 631 illustrates the appearance of the case at the time the band was unscrewed to be removed. While the right lateral had changed its position so that it did not lap over the cuspid (see dotted line), the left lateral had changed

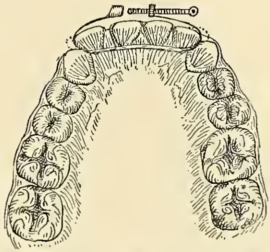


Fig. 631.—Close of First Stage of Operation. (A.)

its position very little. To retain the right lateral in its new position, a small but deep pit was drilled through the approximo-labial surface of the right cuspid about midway of the crown. (See J, Fig. 632.)

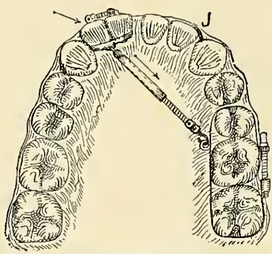


Fig. 632.—Beginning the Second Stage of the Operation with a Screw-jack. (A.)

In this pit, which was of the diameter of a pin, one extremity of a gold screw, J, was set and cemented with phosphate of zinc; the other end (protruding from the tooth nearly one-eighth of an inch) rested closely against the labial surface of the recently moved lateral incisor, as shown. The philosophy of inserting these pegs is explained on pages 393–394. (See Figs. 362–363.)

As the right lateral and central now continued to remain as corrected, and the left lap had not materially changed position, it was determined to leave the two right incisors in their new positions and apply a different device to the left incisors, with sufficient drawing power to overcome the stubborn resistance of their sockets. This device was a swivel screw-jack fastened to a clamp-band around the two incisors, and anchored diagonally across the mouth to a larger clamp-band around two molars and a bicuspid, as illustrated in the same figure (632). Within two days the lap upon the cuspid had disappeared, and the two teeth were brought into place, the centrals being then in close contact, as shown in Fig. 633.

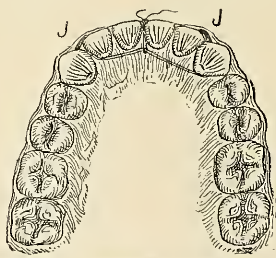


FIG. 633.—At Completion of Operation. (A.)

Having held the teeth in place for a few days with the same apparatus (similarly as with the other teeth), they were then retained by a gold peg, J, set in the left cuspid, after which the approximal spaces between the laterals, cuspids, and pins were filled with phosphate of zinc cement to equalize and, for a time, aid the bearings. The left incisors were also further aided in this support by a thread tied to the right cuspid, as shown in Fig. 633. This retaining thread was used for several weeks. The apparatus was not worn without inconvenience, but as the patient was anxious to have the teeth corrected, and a powerful device was necessary to achieve success, she submitted to the inconvenience without a murmur.

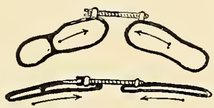


FIG. 634.— Device for Drawing Teeth Together (top view).
FIG. 635.— Same Device; side view. (Palmer.)

Figs. 634, 635 illustrate a simple instrument, devised by Dr. Edgar Palmer in 1886, which is well calculated for cases in which the teeth are so shaped that elastic rubber or strings will slip up under the gums. This device consists of two links of platinum wire about the size of a small pin. These are fitted about the incisors, which are afterward drawn toward each other by a small screw. (See arrows.)

Closing interdental spaces between side teeth by drawing the posterior teeth forward.— Spaces between side teeth are often found; but, generally, spaces in this part of the dental arch are caused by teeth imprisoned within the jaw, or by loss of some tooth or teeth, perhaps by extraction. When, from any cause, a space exists (such, for instance, as would be made by loss of a first bicuspid) the deformity has, in the past, been thought incapable of correction, except by an artificial tooth. While this so-called remedy may be proper, and perhaps the most convenient, under some circumstances (especially with young patients, whose teeth are not so likely to fall over), I think that if the conditions are favorable, it is sometimes better to close the opening by drawing the posterior teeth forward. For an illustration, suppose a first molar to be missing, and the second molar has erupted so as partially to occupy its place, the third molar not having yet erupted; then, if the second molar were drawn forward until it came in contact with the second bicuspid a little while before the eruption of the third molar, and held there until the eruption of the latter tooth occurred, the new tooth would stand against the second molar and serve as a retainer to it. In this way, and by slightly grinding the teeth, if necessary, to perfect the antagonism, the continuity of the grinding surfaces could be secured. So would it be in some cases of loss of the second bicuspid before the second molar had fully erupted; the first molar possibly might be drawn forward (without inclining it) against the first bicuspid, which would soon be followed by the second molar.

In cases where the first bicuspid is missing, causing a space so far forward as to be in sight, it may sometimes be closed by drawing the second bicuspid into its place. Even if the first molar were allowed to remain, the apparent transfer of the space from the anterior to the posterior side of the second bicuspid would place it sufficiently far back to be unnoticeable.[1]

From this process of moving teeth forward, it will be seen that in some operations, such as where the cuspid or lateral is being drawn back by clamp-bands anchored to teeth posterior to them, to make room for jumbled anterior teeth, the possible drawing forward of the anchor

---

[1] Such a tooth, when moved, may be retained by a wire, one end of which is anchored with amalgam in a cavity in the grinding surface of some neighboring tooth, and extending along the sulcus or at the side so as to rest in or around the tooth moved; but it will frequently be found that the tooth may be retained more easily by a detachable skeleton device, or even by a plate.

teeth (posterior to a lateral or cuspid), instead of being detrimental, may, under some circumstances, be a benefit. This remark is made because some dentists, while recognizing the benefits to be obtained from the anterior end of the apparatus, seem to be unmindful of possible advantage to be derived from the other end.

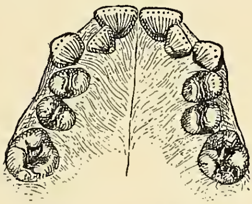


FIG. 636.—Before Operation; three-fourths size.

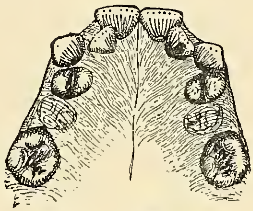


FIG. 637.—First Step in the Operation.

Case.— To show this possible advantage, I will take a case upon which I operated in 1881, that of a boy, the original condition of whose teeth is shown in Fig. 636. The lips, being already full enough, did not permit of enlargement of the arch; therefore, to make room for the cuspids and laterals, some of the teeth required to be extracted. After due consideration, both of the second bicuspids were taken. This left the case as shown in Fig. 637. To move the first bicuspid backward so far as to make room only for the cuspid and lateral, would have left a space between the first bicuspid and molar on both sides of the arch, which, in this case (the boy having a large mouth), would have been exposed to view unless the molars were drawn forward, which was done.

The clamp-bands were then placed around the bicuspid and molar on each side of the mouth, as illustrated in Fig. 638, and were tightened until these teeth were brought into contact. The third step was to move the cuspids back out of the way of the laterals by splice-bands, applied as shown in Fig. 639. These were first caught at one end over hooks on the lingual sides of the anchor-bands, after which they were carried around the cuspids, then connected on the buccal sides of the same bands by means of bolts screwed into triple nuts on their posterior portion, as shown. By the time the bicuspids and cuspids were moved sufficiently far back to make room enough between the cuspids and centrals to admit the laterals, the molars had moved forward and closed the spaces. To move the lateral incisors outward to line, a gold long-band was connected by a lock-screw at each end with triple nuts on the anchor-bands,

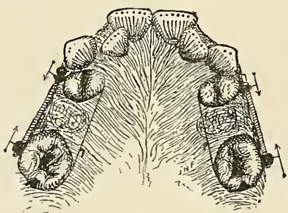


FIG. 638.— Second Step. (A.)

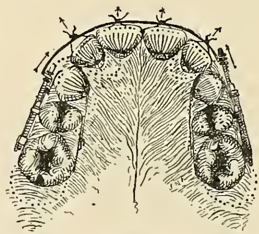


FIG. 639.— Third Step.—Drawing the Laterals to Line. (A.)

after which the laterals were tied to it by strings, as shown in the figure, which illustrates the case at the close of the operation.[1]

Fig. 640 shows the dental arch after the apparatus was removed. It exhibits also, by the dotted lines, the original positions of the different teeth moved, which (by comparison with the plain lines) show the relative changes brought about by the operation.

[1] For details of the construction of this mechanism, see pp. 233–238, 330, 424, 425.

All that now remained to perfect the case, esthetically, was to turn the mesial sides of the centrals a little outward; but, as the patient was satisfied with the improvement thus far made, and was about to start on a foreign tour, the turning of these teeth was not attempted. The presentation of this case is not intended to imply that moving a molar tooth, so far forward as to incline it, is advisable.

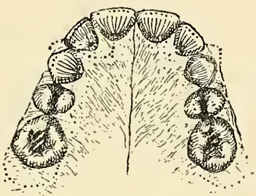


FIG. 640.—Appearance of the Case when Completed.

How posterior teeth can be moved forward when the anterior teeth are insufficient for anchorage.—In some cases the anterior teeth alone do not furnish sufficient anchorage for drawing posterior teeth forward, without moving them (the anterior teeth) out of place. In such cases, success may appear to be impossible; but, though necessarily difficult, it is by no means impossible, for the anchorage resistance of the anterior teeth can be aided by properly constructed mechanical devices bound to them and some other portions of the dental arch. I cannot imagine a case where there is a space of not more than a fourth of an inch, or even somewhat wider, between the bicuspids and molars which cannot be successfully closed by judicious use of such aid.

Case.—I rarely find a side space that cannot be closed by simple devices, such as shown in Fig. 639. Occasionally, however, I resort to other mechanisms, and, notwithstanding some of them are complicated, they are worthy of being mentioned, because they do excellent work when simpler ones fail. One of the simplest of these devices is illustrated in Fig. 641, as applied to a case in which the first left bicuspid was lost, the first molar only being present, and the second molar about to erupt.

In detail, this apparatus is as follows: For anchorage, a clamp-band is first bound around the two right bicuspids and the first molar. To the double nut on the posterior portion of this anchor-band is then screwed (by a second and longer bolt) one end of a stiff long-band, the other end of which is bifurcated, and the fingers so bent that one hooks around the lateral incisor and the other

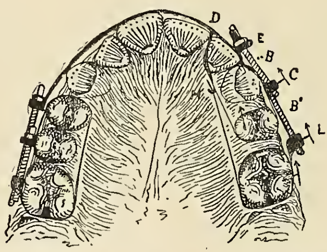


FIG. 641.—Drawing Side Teeth forward, the Anterior Teeth being insufficient of themselves for Anchorage. (A.)

rests upon the cuspid, as shown. These fingers are simply to aid in supporting this end of the long-band. The teeth to be moved are connected with this long-band by a modification of a small clamp-band and splice-piece, so constructed that one end of the ribbon of the clamp-band is attached by solder to the long-band at the point D, and the other end (at the point C) by a screw B to the lug E. Having the long-band in position, the clamp-band is placed around the second left bicuspid and tightened by the screw B. This draws the tooth forward to the cuspid. The figure represents the bicuspid as having already moved one-half the desired distance. When the bicuspid is drawn quite in contact with the cuspid, the molar is then harnessed to the fixture by means of the splice-band (here shown in advance of the proper time), one end of which is caught upon the hook H of the anchor band, the other end being connected by a long screw, B′, one end resting in the nut L, the other in a second hole in the lug E on the long-band, which screw, when tightened, draws the splice-band on the molar and moves it forward. (See arrows.)

By the use of the long-band, D, this anchorage to the drawing portion of the apparatus, B B′ C L, is distributed along all of the teeth embraced under it and those within the right anchor clamp-band. But, as the strain is greater on the left central and lateral incisors than on the remaining teeth on the right, they are apt to be drawn inward somewhat if too great a degree of force is applied. Should the change in their position be slight, they will, if liberated, generally return to their proper places.

It will be seen that by drawing forward the bicuspid and first molar a few weeks before the appearance of the second molar, the operation would permit the second molar to move forward of itself and erupt anterior to its normal position and closely behind the first molar; thus making practicable the continuity of the antagonizing surfaces. After such an operation any interfering cusps should be ground to improve their usefulness in mastication of food.

Case.—Fig. 642 shows a modification of the preceding device, as applied to a case after the second molar had erupted. While the device as illustrated by the last figure (641) is often sufficient to close a space by half-developed teeth —to stay the anterior teeth, and prevent them from moving inward in closing spaces by fully developed teeth, sometimes requires additional support. A stiff wire or, better, a screw-jack, extending from one extremity of the anchorage device B, to the other end of it, will meet the difficulty. In this figure the device is shown as applied, in the first stage of the operation, to both the bicuspid and first molar, but, in practice, the splice-band is not applied to the molar until the bicuspid has been drawn up against the cuspid.

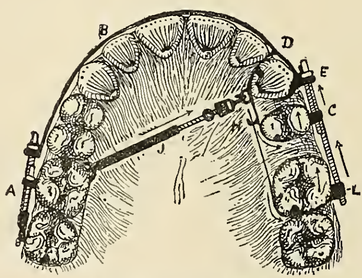


FIG. 642.—Drawing Forward Stubborn Side Teeth to Close a Space, by Means of a Clamp-band and Splice aided by a Long-Band supported by a Screw-Jack. (A.)

The long-band portion is applied in a manner similar to the preceding one. The screw-jack J is then added by hooks or rings, as shown, after which the jack is elongated until it braces firmly against the teeth at each end. Should the left extremity of the jack prove to be too far back for sufficient aid, it may be attached further forward, say the width of one tooth, by means of a U-shaped strip of plate soldered at each end to the long-band (not shown in the figure), so as to relieve the left incisor. The long-band should rest close to the gums.

It is seldom prudent to attempt to move a second molar forward after having moved the first molar. The operation can only be recommended when some of the antagonizing molars are missing, and the moving of the second molar just before the eruption of the third will (when the first molar is missing) improve the antagonism.

Closing a space by laterally moving both roots and crowns.—The lateral movement of the entire tooth has been regarded as difficult; and (in referring to successes claimed by the author) Dr. Guilford has even gone so far as to state, in some remarks he made at a meeting in 1888, that he had "always inclined to doubt" the accomplishment of the operation.[1] Not only have I performed the operation several times, but I have advised its performance by others who have found it to be fully successful.[2]

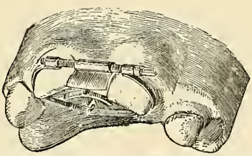


FIG. 643.—Lateral Movement of the Crowns and Roots of Central Incisors to fill an Interdental Space. (A.)

FIG. 644. — Device used for the Movement, shown in detail. (A.)

The secret of effecting a lateral movement of roots lies in relatively fixing the antagonizing ends of the crowns while force is being applied at their necks.[3] The principle of this is shown in the explanation of the operation in the following case:

This patient was a boy who had lost his four upper deciduous incisors, and whose adult centrals had straggled and erupted one-fourth of an inch apart, interfering with

1 "Dental Cosmos," July, 1888, p. 505, last paragraph (A).

2 Among these men is Dr. O. E. Hill.

3 First explained in the "Dental Cosmos," Vol. XXIV., 1882, p. 190.

the advance of the adult laterals. The mechanism devised for the operation is shown as applied in Fig. 643, and separately in Fig. 644.

It comprises two parts, a clamp-band to draw the teeth together, and a guide-lock to prevent the ends of the crowns of the teeth from overlapping when brought tightly together during the second stage of the operation.

On each extremity of a light but strong band made of rolled gold wire a nut is soldered. One of these nuts is screw-cut, the other smooth-bore. Through them passes a gold screw, having a head fitted to a watch-key, all of which is similar to a clamp-band. The main point in constructing this band is to insure a closer bearing at the gum border than elsewhere, so as to render the device less liable to slip off the teeth.

FIG. 645.—Modification of Guide-trough. (A.)

Fig. 645 shows a modification of the guide-lock; *a*, edge view of the trough and ferule; *b*, side view of a septum; *c*, the three parts united.

Though this guide-lock is not so cleanly as the one shown in Fig. 644, it is much easier to make. It is constructed by bending a small piece of plate, about half an inch long and a quarter of an inch wide, into the shape of a trough, as shown in *a*, to fit the cutting ends of the teeth. To this trough is soldered, at right angles, another piece of plate *b*, extending from the cutting edges of the teeth up nearly to the gum. On the upper end (of both pieces, *a*, *b*) is soldered, transversely, about oue-eighth or one-fourth of an inch of small tubing, *c* (smooth bore), through which the bolt of the clamp-band passes, and holds the trough in place.

When beginning to operate, the clamp-band, without the guide-trough, is placed upon the teeth, and worn for several hours, or a few days, force being intermittently applied by tightening the screw once every six hours, or oftener if the band loosens by the movement of the crowns of the teeth toward each other. After the teeth are brought in contact, or nearly so, the trough portion is added, and the action of the clamp-band is continued and maintained, which draws the parts toward each other until they are in the position desired.

If it be difficult to retain the apparatus in position in the later stages of the operation (on account of the inclination of the teeth toward each other), the crowns of the teeth should be held a short distance apart by a block of gold soldered in the trough and worn until the roots are drawn to their proper places, when the block should be filed out and the crowns drawn into contact. The device may sometimes be held sufficiently firm, however, by a block of elastic rubber tied to the septum or perpendicular piece, *b*, to rest in a V-shaped space between the teeth.

After the operations I generally use the same fixture to retain the teeth in position until they become sufficiently firm in their new quarters. It is not necessary to keep them in "splints" until the unerupted teeth fully appear. A slight encroachment of the stragglers, caused by reaction, will do no harm.

It is important that food, accumulated between and around the teeth and apparatus, should be removed. This may be accomplished, in a measure, by gargling the mouth with water; but to insure against mischief (such as from carelessness or neglect), the device should be removed daily.

In a case like this, the operation is one of the easiest imaginable, and compared with the old-fashioned method of using slippery strings and rubber, which often caused failure, it is another of the many examples that regulation of the teeth is made easy by apparatus constructed properly as means to ends. (See other operations, Part XV, Vol.2.)

FIGS. 646, 647.— Artificial Teeth on Half-round Wire to fill Interdental Spaces.

Spaces filled with artificial teeth.—When a space is caused by the absence of a tooth, from non-development, and this space cannot be closed by moving the neighboring teeth, it may be filled with an artificial tooth. A full explanation of the process of constructing such works of art does not strictly belong to a treatise of this character. I shall, therefore, make only brief remarks concerning their manufacture. Whatever tooth is inserted, I think it should be mounted upon as delicate an anchor as is possible to be consistent with strength. I often mount artificial teeth for these cases upon U-shaped gold plates, about one-fourth of an inch in width but of double thickness; but when there are only one or two such teeth to be mounted I prefer half-round gold wire.

These dentures also serve as retaining devices to prevent straggling and separation of adjacent teeth. Fig. 646 represents such a retaining denture, which, in April, 1882, I inserted for a woman who never had any natural upper laterals. During the same year, I filled the spaces made by the absence of two upper cuspids by a similar device. Fig. 647 shows another one, which, in June, 1883, I inserted for a girl who had no upper left lateral. A U-shaped anchor, made of plate for the support of artificial teeth, is, of course, not new; but half-round wire (so far as I know) was not used for this purpose before my own efforts with it. These skeleton retaining dentures, when made of half-round wire, are difficult to properly fit in the mouth, and even when fitted they are easily bent "out of true," unless the patient exercises care in removing and replacing them; but because of their delicacy in form they are much admired by those who have them in use.

Interdental spaces filled by implanted teeth.—The implantation of foreign natural teeth (in holes bored into the alveolar tissue) for filling interdental spaces, is at present a comparatively new treatment introduced by a dentist named Younger. This modification of an old-time operation, called "transplantation" described by Paré (in a treatise published in 1579), is at present receiving some attention, owing to the fact that for a time the tooth, if skillfully set, generally becomes firmer than by the old operation of setting foreign teeth in natural sockets. Indeed, these teeth are frequently found so firm as to give a metallic sound when struck with a steel instrument. It is now too early to determine whether this operation will prove to be more lasting than that of "transplantation." Although the microscope has thus far shown the union between the alveolus and the tooth to be mainly, if not entirely, mechanical, and that some of the roots have already undergone disintegration, becoming porous, and have been ejected naturally, it is thought that even if greater skill in the operation does not lead to physiological union, the results of the process may last a sufficiently long period for the operation to be satisfactory to some patients. The records thus far furnished show that the most successful operations are those in which perfect teeth recently extracted from young people have been used; but even some of these, under the most favorable circumstances, have proved failures. As an illustration of such failures, a case reported in the "Dental Cosmos," June, 1888, will now be given.

A gentleman in sound health, thirty-eight years of age, had lost in the Franco-Prussian war two bicuspids in the lower jaw. A dentist, accredited with great skill, had implanted two others in their places. They soon became firm, but in less than three months one loosened and fell out, and it was necessary to take out the other shortly afterward. The condition of this one (according to Dr. Merrill, who reported the case) is shown in Fig. 648.

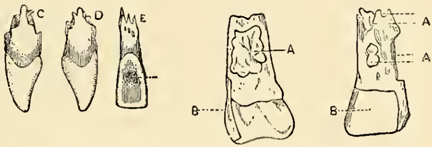
FIG. 648.—Final appearance of an Implanted Tooth.

In this case the decalcification began at the point of weakest cemental contact, and proceeded downward and inward to the root-filling, which was of gutta-percha. Thus, in less than two years, both operations proved complete failures in a subject whose physique was especially favorable to the experiments.

To show how this tooth was affected similarly to those transplanted in old sockets, two other illustrations from the same journal are here given. See Figs. 649, 650.

C, D, E illustrate the places of absorption of the root of a transplanted tooth after eight months.

A, B represent a lower right third molar, five years after it had been extracted and replaced. A is a cavity formed by absorption; B, a gold filling. The figure on the right gives another view of the same tooth; letters as before. Whether future experience in implantation will prove that teeth can be made to remain useful for five or ten years, it is, at this time, difficult to determine, but there are dentists of eminence who believe it possible, and regard it as worth a trial. As to the best method



FIGS. 649, 650.—Appearance of two Transplanted Teeth.

and proper shape of instruments for performing the operation, the time has not yet arrived for decision. Improvements in both particulars are being made as rapidly as experience suggests, and probably will continue until the operation is either established or abandoned.

There is, however, another phase of this practice which cannot be too strongly deprecated. I refer to the extraction of a misplaced tooth, such, for instance, as a cuspid standing in the place of a lateral, and implanting it in its proper place, instead of moving it laterally through the alveolar process by the usual method for correction of irregular teeth. This operation, though recommended and practiced by some dentists, is, in my opinion, carrying implantation too far, because the tooth so treated not only becomes pulpless, but it cannot have as healthy an appearance as if moved back and kept in its normal and vital condition.

PART XIV.

Extraction of Teeth for the Prevention and Correction of Irregularities.

CHAPTER LXII.

EXTRACTION OF TEETH FOR PREVENTION AND CORRECTION OF IRREGULARITIES.

EXTRACTION VERSUS NON-EXTRACTION.—FACIAL EXPRESSION GENERAL REMARKS.

THOUSANDS of teeth are extracted daily for no other object than to relieve patients from toothache, or to make way for artificial dentures. The evil of this practice is far-reaching, and those who permit themselves to lose teeth that might be saved are very unwise, especially so if they have the time, means and opportunity to preserve them. The degree of value placed upon the different teeth depends upon the degree of education as to their importance. There are people who exercise excellent judgment regarding other matters, but whose lack of knowledge upon this point shows itself in indifference concerning the fate of their teeth. The holders of different views on this subject may be divided into three classes: 1st, Those who are indifferent as to saving any tooth in any position, and resort to extraction simply as a relief from pain; 2nd, Those who, from ignorance of the fact that health and also the contour and complexion of the face largely depend upon the side teeth, are indifferent concerning these teeth, but anxious to save those that are exposed to view; 3rd, Those who, knowing that health, comfort, and beauty so largely depend upon the presence of the teeth, are desirous of saving all, at whatever cost of time and money, whenever it is possible to do so, and consent only to lose a tooth when it is impossible to save it, or when its extraction is necessary to relieve an overcrowded state of the dental arch.

The subject of extraction for the purpose of relieving pain, is not strictly relevant in a work devoted to the correction of irregularities, and therefore the operation will be dealt with, here, only with reference to its agency in the process of improvement (or prevention of detriment) to facial appearance; in other words, no attempt will be made to explain the art of extracting, but to show why and when to extract in regulating teeth.

Opinions differ widely upon the benefit of extraction for either of these purposes. Some operators declare that three-fourths of the cases of irregularity might be prevented by the use of the forceps; others, on the contrary, assert that more deformities are brought about by extraction than by all other causes combined; that in fact, extraction shapes the conditions that lead to disfigurement. On close examination, this latter opinion will be seen to rest not so much on a scientific basis as on observations of the results of injudicious extraction, from a want of sound judgment as to which teeth should be extracted, and the proper time for doing it. The correct decision upon these points involves the power of foreseeing the results of each step of the process, so as to avoid creating a new difficulty while removing the original one.

In many cases, I regard judicious extraction as one of the most essential requisites for the prevention and correction of irregularities, for by it overcrowding is often prevented, complicated cases are simplified, and the tediousness of the effort necessary to save all the teeth (an effort sometimes useless) is much lessened. On the other hand, injudicious extraction may in the end not only complicate the operation for regulating and render it more difficult, but also, by removing the support of neighboring teeth, cause some of the others to tilt, thus impairing the antagonism. To lay down definite rules, however, that will apply in all cases, is impossible ; therefore only suggestions, or, at most, approximate rules, will be attempted. The common sense of the operator, guided by experience and by observation of the cases in which mistakes have been made (which are frequently seen in practice), must supply the rest.

If overcrowded teeth are relieved by extraction of one or more, the remainder will generally move toward the proper line. The reason why teeth tend to arrange themselves on a line corresponding to the top of the ridge of the alveolus is that the alveolar tissues along this track offer the least resistance. Not only are the sides of the alveolar ridge denser than this track, but the outer plates have also a slight degree of elasticity, so that although the flexibility of the tissue (which is not to be confounded with its elasticity) will sometimes permit an overcrowded tooth to force its way from under it, the making room by extraction of an interfering tooth, if it is not allowed to remain until molecular changes have destroyed this property (elasticity), will often be sufficient for this higher degree of hardness, together with the power of elasticity in the alveolar plates, to force the outstanding tooth into line, even though it be obliged to glide diagonally past another tooth (as is frequently the case with a cuspid that erupts in the anterior position, standing outside of the laterals and first bicuspids), in its movement to fall into the place of the tooth that has been extracted.

The Age at which it is best to regulate Teeth varies with circumstances. Some writers assert that the difficulty increases with age. It has not been so in my experience. Although the teeth of children move more easily when the proper degree of force is applied, yet these teeth are sometimes so short that to use anything except the inclined plane would often be impracticable, and even this is not always efficient. While the upper anterior teeth can generally be regulated by this instrument, the correction of the lower set by it is more difficult; and, as the inclined plane is not invariably practicable, it is sometimes necessary to wait until the teeth erupt more fully, when an elastic rubber ring drawn over, around, and between the teeth, and anchored in such a manner as to act in the right direction, will often suffice to perform the correction. From the tenth or twelfth to the fifteenth year, the teeth are generally sufficiently developed to permit the use of other devices. In my practice, I find that, if there is any period of life at which teeth can be regulated more easily than at another (taking the aid derived from the intelligence of the patient into consideration), it is between the ages of twelve and eighteen; but this fact is greatly modified by the health and temperament of the patients.

Before the twelfth year, children have but little personal pride, consequently they generally require to be controlled by the parents and the operator, in order to make them obey instructions. After that age, until about eighteen, they have an increasing interest in personal appearance in anticipation of "entering society," and they are, therefore, more influenced by counsel. This period reached, young people are apt to hesitate, as to the regulating process. if they do not decline it altogether, on account of the disfigurement sometimes caused by wearing devices and the interference with ease of speech. This reluctance on their part sometimes renders them as difficult to control as younger children. It can, however, generally be overcome by a little advice kindly given, and the selection of a convenient season of the year for the process. After marriage, the principal interference arises from domestic duties; but such objections may also be occasionally removed. In all cases, it is desirable that the patient should co-operate heartily in the work of the dentist, and it is well to impress on young people that such unimportant objections as those above named ought not to weigh against the lasting benefit to be derived from the correction. Although teeth are more easily corrected at the above-mentioned ages, it should not be understood that a greater age is a bar to success. I frequently regulate cases that are forty and forty-five years of age and sometimes older, but I think that such cases should always be treated with screws. (See Part XX., Vol. 2.)

Deciduous Teeth.—The first teeth to receive attention in the following chapters will be those of the deciduous or child's set, after which the adult teeth will be considered. Contrary to the general notion, I regard these (deciduous) teeth as of great importance, because, although apparently only temporary in character, they supply the wants of the individual at the most tender age, when mastication depends rather upon instinct than intelligence, and when the digestive organs are so delicate that they are more severely injured by the results of imperfect mastication than is the case with adults.

The extraction of deciduous teeth would be a short story and easily told, if the jaws were always in proper proportion, and the development and eruption of the second teeth were normal, for unless a deciduous tooth is the cause of pain or disease of the socket it ought not, except in rare instances, to be removed until the successor is ready to take its place. Deciduous teeth, by the assistance of their successors, frequently, if not generally, attend to this matter themselves through resorption of the roots, leaving the crowns to fall off by their own weight, or to be plucked away, owing to the peculiar sensation that leads the finger to pick at them. This slight tendency, not altogether unlike the desire to bite upon hard substances when teething, induces the child, unconsciously, to persist in the act. The clearing of the track for the second teeth is more frequently found to be accomplished by nature, in country than in city life. When, however, the extraction of a deciduous tooth is called for, it becomes very essential. What the conditions are that indicate extraction will be explained later.

Upon the "Contraction of the Jaws" from Extraction.—Formerly, it was the general belief, and even now the opinion of some dentists is, that premature extraction of deciduous teeth causes contraction of the jaw. While the premature removal of a deciduous tooth may lead to irregularity, as in case of the upper cuspid, which generally erupts later than the first bicuspid, and even sometimes in the case of the lower cuspid, which, although generally erupting before the first bicuspid, sometimes erupts later,—the lack of room, as explained in the chapters on Etiology, does not appear to be due to shrinkage of the bone, but partly to an arrest of the growth of the alveolus at the stage when extraction took place; and partly, if not principally, to the forward movement of the teeth that are posterior to the space made by loss of the deciduous tooth. This appearance of shrinkage is of course greater where several teeth are prematurely extracted.

As stated in the chapters referred to, the jawbone, taken in its entirety, is made up of what may be termed for convenience of expression, permanent and changeable bone. The foundation or framework of the jaw is permanent; but the alveolus has something of the nature of provisional bone, because a considerable portion of it is apparently present solely for the mechanical support of teeth, and when it is no longer needed to hold the teeth in place, nature removes some of it by resorption. This change in the alveolar process after loss of teeth is evidently brought about by the same law that governs the reduction of other unused tissues, although, as explained under the head of Etiology, the wasting of the ragged or thin socket portions of the alveolar ridge is partially for the better fitting of the substructure of the gums, for masticating purposes. This wasting is sometimes greater than is desirable, for where only one tooth is lost, the absorption of the socket is occasionally so extensive as to reduce and injure the nearer walls of the adjacent sockets; thus leaving the roots of the teeth in them partially exposed, but as this point has been discussed at some length in the above-mentioned Part, it is not necessary to consider it further here.

Toothache in Infancy.—Extraction or Non-extraction.— A knowledge of the time and order of eruption of the second teeth is of course necessary to guide the proper treatment of the first teeth. As before stated, an impression prevails that deciduous teeth should never be removed until the successors are ready to appear. This would certainly be a correct and easy rule to follow if all acts of nature were normal; but there are three conditions that render the following of such a rigid rule injudicious. One of these is, when the presence of a deciduous root would guide astray the successor or its neighbor, thus causing irregularity: another, when the rootless crown of a deciduous tooth, by becoming fixed between the crowns of adjacent teeth, prevents the eruption of the successor; and lastly, when its retention would cause great and persistent pain. Whatever the influence upon the second tooth, it must be apparent that it would be inhuman to allow a child to suffer the torture that an adult would not tolerate. Of course, it is generally better to relieve pain by other means than extraction, such as filling; but extraction, like lancing the gums to relieve pain, should be practised rather than permit a child to suffer continually. Toothache has, indirectly through indigestion, consequent upon improper mastication and through irritation of the nerves and brain, been the cause of the death of thousands of children.

The question of expediency in the removal of the deciduous teeth, as found in practice, is not always an easy one to decide, for the complex nature of the arrangement of the second teeth in the interior of the jaw in the early stage of their development, and the vicissitudes due to their environments during growth, together with their disorderly eruption, is sufficient to cause timidity on the part of inexperienced practitioners. But an experienced dentist, who thoroughly understands the subject of development of teeth, if he has frequent opportunities of seeing the child, especially during the period of eruption of the cuspids and bicuspids, can do much to prevent irregularity by judicious extraction of the deciduous teeth.

FIG. 651.—Showing the changes in the form of the Alveolus and Position of a Central Incisor between Twelve and Twenty-one Years of Age (Black).

What constitutes judicious extraction is of course a matter upon which opinions vary, because sometimes (though rarely) room for the second teeth is offered by slight growth of the jaw, but more by growth of the alveolar ridge and the tilting outward of the teeth sufficiently early to render unnecessary the removal of the adjacent deciduous teeth before their time. This change of form and position is often brought to notice by the separation of the front teeth between the ages of four and six years and before the eruption of the incisors. This growth of the alveolar ridge is well exemplified in Fig. 651.[1]

To remove the deciduous teeth prematurely might cause scattering of some of the second set, but sometimes the only proper course is to extract the adjacent tooth to prevent the turning aside of the new teeth. In some circumstances of rare occurrence, it may be necessary to extract a child-cuspid to make sufficient room for an adult-lateral, and then possibly in time also to extract the first bicuspid, in order to allow space for the new cuspid, as will be explained in a later chapter in this Part.

Some conditions of irregularity are so complex that they may be aptly described as "jumbled," but the degree of this overcrowding, as found in nature, varies. As this disturbed arrangement is generally due to lack of alveolar territory, caused either by carelessness in regard to the deciduous teeth, or to natural smallness of the jaw, our first effort should be to evolve order from confusion by enlarging the arch, or by reducing the number of the teeth, or both, so as to afford room for them to stand in line. Before entering on the details of complicated operations, the attention of the reader is first invited to the simpler ones, which are based mainly upon extraction, after which, step by step, the aid of mechanical devices will be called in. In explaining these processes, a certain amount of repetition will become apparent. This is unavoidable, as the processes blend into each other, and is necessary in order to simplify the subject so that it will be clear to the beginner. The follow-

[1] See also page 91.

ing chapters are devoted to describing, separately, the various conditions so as to define those found in special periods of life, dealing first with the treatment of deciduous teeth to prevent irregularities, and then with that of the adult set for their correction. In doing this, as above implied, certain descriptions and directions will be found applicable to both.

As has been already said, extraction of any of the adult teeth for the purpose of correcting irregularities, except in very rare cases, is regarded by some operators as improper; on the other hand, there are those who advocate extraction in nearly all cases as the best plan, and they resort to it with such blind faith that it would seem that no tooth is regarded by them as more valuable than another, and that any one may as well be lost as another if it stands in the way. In fact, this matter of facial expression, as depending on the teeth, is ignored.

Of course, the age, health, habits, temperament, social position, and business circumstances of the patient should be taken into consideration in determining the process that ought to be adopted for correction of dental irregularities. Besides these, the question of finance is to be considered. One person may be able and willing to pay five hundred dollars for an operation; while another may not be able to pay ten. Even the rich are occasionally disposed to be economical, and in such cases, a dentist is sometimes led to practise the easiest and cheapest method, even against his own judgment. However, as our object is mainly to deal with the scientific aspect of the question, these considerations will be made subordinate to it.

If, as remarked above, the correction of irregular teeth depends much upon making room for them to form in line; then the proper course is to do away, so far as is possible, with any existing cause of interference, such as the crowding of adjacent teeth and improper antagonism. This may be attained by grinding off interfering points, as described in a preceding Part, by extraction of some tooth or teeth, or by forcibly moving them. Assuming that we have only adult teeth to correct, and leaving other considerations out of the question for the present, looking at the subject from a scientific point of view only, we will first examine the phase of making room by extraction.

The controversial point to which nearly all differences of opinion among dental authorities gravitate, is not so much as to the need of extraction as the question of which teeth should be extracted. The battle-ground lies along a line extending from the central incisor to the second molar, but not including either the former or the latter. This question may be divided into three parts, namely : 1st, the relative value of the cuspid and first molar of the deciduous set, and the first bicuspid ; 2nd, of the bicuspids and the first adult molar ; 3rd, of the upper adult cuspid and lateral incisor. The question of extraction necessarily includes that of prevention of decay, but our remarks will not be made so much with reference to that point, as to making room for overcrowded teeth, and the liberation of imprisoned unerupted teeth ; still, it will be considered.

Facial Expression to be regarded.—Some persons think that all adult teeth should be retained at all hazards, regardless of their effect on facial appearance ; while others hold that all teeth should be preserved, provided they do not injure the expression of the face, but not otherwise. With the last opinion I coincide. To tell a patient that all the teeth should be saved, simply for the purpose of having sixteen in each jaw (even though they cause the lips to protrude like those of an ape), seems to me to be, at least, questionable advice. While mastication is of prime importance, and should perhaps be the first consideration in dental operations, an attractive personal appearance is so important that, so far as it depends upon the presence and condition of the teeth, it should never fail to receive attention from the dentist. An artistic operator studies facial expression as well as antagonism, and as esthetic improvement calls for higher and rarer talent, it generally needs more time and care. The artist examines the face from all angles. He especially studies the profile and region around the lips to see if they are in harmony with the upper portion of the face, and, if not, endeavors as far as possible to make them so.[1]

If the lips are already too full, the enlargement of the dental arch, of course, cannot improve the face; and if not full enough, extraction might greatly injure the appearance, for should the arch afterward be enlarged to round out the face it would scatter the teeth, and, being unsupported laterally, some of them would tend to fall sidewise. If the lips and cheeks are not full enough, then the saving of all the teeth and enlarging of the arch may be proper; but, as before said, if this part of the face is in harmony with the upper part, and the teeth themselves are overcrowded and irregular, then common sense would suggest that room should be made by getting rid of one or more; and, if some are more important than others, the extraction should fall upon the less important.

If the lower arch is of the proper size, and the upper much smaller, then the upper should be enlarged at least sufficiently to obtain proper antagonism. This generally affords room for all the teeth to move into line; but, if the teeth would, after this operation, continue overcrowded, then extraction of one or more would also be advisable.

The utility and quality of the teeth are important considerations in forming a judgment regarding extraction; as,

---

[1] For a more exhaustive treatment of this subject see the last Part in Vol. 2, which is entirely devoted to Esthetics in Dentistry.

for instance, a sound or even a slightly defective first molar is of greater value (because larger) for mastication than a sound bicuspid. The bicuspids are generally the most perishable teeth of the set, but, if the first molar is very much decayed, then its value and permanence is greatly reduced. To sum up : The question to settle in this matter is, which tooth is likely to remain the longest, and be on the whole the most useful?

CHAPTER LXIII.

SUPERINCUMBENT TEETH.

EXTRACTION OF TEETH IN PAIRS.—ABSENCE OF "GERMS" OF SECOND TEETH.—CASES.

BESIDES unerupted teeth in abnormal positions, such, for illustration, as those that lie horizontally in the jaw, a condition which is of itself sufficient to cause in many cases irremediable defects in the dental arch, there are frequent instances in which one or more teeth are hemmed in by superincumbent erupted teeth that would take their proper positions if some aid were given them. This aid may be afforded by extraction, or by moving away adjacent teeth; the former in many cases is the better plan, because it radically clears the track of obstruction, and also often prevents what, at a later day, might become a deformity requiring expensive and long-continued treatment. It is proposed to dwell further on these considerations, but at present only a brief abstract of results will be given.

Superincumbent teeth, standing in the way of the development of others, may belong to either the first or second set. Though sometimes it may be a little difficult to determine about extracting teeth, with careful consideration there is but little danger of mistakes. Extraction is the general rule, but it is not prudent to resort to it in all cases; for it might happen that the teeth, supposed to have been liberated, would never appear. With some people there are no germs even of the laterals, cuspids, and bicuspids; yet it is not always easy to convince them of this fact, nor that the extracted deciduous tooth was not one of the second set. For this reason it is not possible to make a rule suitable to all cases.

Ought deciduous Teeth to be extracted in Pairs ?—In the case of deciduous teeth I do not think it well, as a general rule, to extract until it is quite certain that the successor is near, and, as it were, "knocking at the door." A question familiar to dentists may now be in order: "Ought deciduous teeth to be extracted in pairs?" This question is partially answered by the foregoing remark. If there is strong evidence of the early appearance of a successor, or that the successor lies in such a position that the least assistance will aid eruption, it is generally better to extract the deciduous predecessor. The best moment for this is occasionally difficult to determine; for, although late extraction is sometimes better than total omission of it, yet too early extraction might cause disfigurement for an unnecessarily long period. The first instance of this error came to my notice in 1864 in the person of a girl whose teeth were operated upon by one of the believers in the doctrine of "Extraction by Pairs." For five years she was by this act deprived of one of the central incisors. As she went much into society, she endured considerable mortification from this disfigurement, and was further annoyed by being frequently told that she had "lost a permanent tooth" instead of a deciduous one, and that she ought to use an artificial substitute to fill the space.

Absence of "Germs" of second Teeth.—The presence of a second tooth, even when quite deeply seated in the jaw, may generally be known by the contour of the gum, sometimes accompanied with a heightening of its color. The depth of the tooth in the jaw when it has reached the base of the gum tissue can generally be approximately ascertained by carefully passing the fingers over the gum or by moving the deciduous tooth back and forth, either of which acts will cause the tissue to change to a lighter hue. The degree to which the deciduous tooth will tilt will also aid the experienced hand and eye to judge very nearly the extent of absorption that has taken place in the root. But this latter test, unaccompanied with fullness of the gum in this region, cannot be relied upon as proof that the adult tooth is underneath, or that it really exists; for, even where there are no successors, the root of a deciduous tooth in time is found to pass away by absorption sufficiently to permit the

FIG. 652.—Section view showing the Relative Position of a wasted Deciduous Incisor and its Successor.

easy tilting of the tooth and finally the falling of the crown. I subjoin a few selected cases, in order to illustrate this point.[1]

Case I.—The first is a case in which there was no appearance of a left upper adult cuspid. The patient was about twenty-seven years of age. For some years I had noticed that the (left upper) deciduous cuspid was becoming looser until the crown finally fell off without a root. After waiting several months, no successor appearing, I probed the gum and alveolus with a small sharp-pointed straight steel needle in search of one, but found no evidence of any. This

[1] It may be apropos to state here that the author does not propose to burden the reader with accounts of "office cases" in this work further than is necessary to clearly illustrate the points in question. Whenever it is possible to adhere strictly to scientific argument on the subject, it is the intention to do so.

was about five years ago, and as yet there is no sign of a successor. It is only one of many such cases.

Case II.—To illustrate the error of premature extraction, even in cases where there are successors, I will mention the case of a girl, fourteen years of age, who had at one time a pair of deciduous upper central incisors extracted; one of the successors appeared soon after, but the other did not erupt for several years, and then only partially and high up under the lip. It remained in this position for a year or two, when, by artificial aid, I drew it down into place. But, as the adjacent teeth had encroached upon its territory, these had to be moved out of the way first. This case shows that extraction for the liberation of imprisoned teeth may be followed by disappointment; but, as already said, mistakes can generally be avoided by careful examination. It is often better to be a little slow than to be too hasty. While for immediate esthetic reasons, it may be proper to let the upper deciduous teeth (anterior to adult molars) remain, when they show no signs of successors, I am inclined to think that it is sound practice to extract lower deciduous molars, in their usual order, as the proper time arrives, as these teeth are only occasionally found without successors. Even the upper deciduous molars, I think, should be extracted if the alveolar process about them is slightly full, —especially so, if the successors are overdue, and the deciduous teeth set low in the gum, as if they were being grown over by it; the latter condition is an evidence that they are bound in by adjacent teeth. If the alveolus shows no fullness, but is thin and sunken, and if the tint of the gums is normal, it is strong evidence that there is no successor, or if one is present it is so deep or so malposed that it will not soon, if ever, appear. Therefore, extraction under such circumstances would be imprudent.

Case III.—Another case was that of a woman twenty-one years of age, who waited until the usual time for the eruption of the adult lateral incisors and cuspids in the upper jaw, when she had the deciduous cuspid and lateral of the right side extracted in order to give the supposed imprisoned successors an opportunity to erupt; but they never appeared. For some reason the corresponding deciduous teeth on the opposite side were not extracted, and they yet remain sound. I have known adult teeth to be imprisoned so long that they did not appear even after the door was thrown open by extraction of the predecessors.

Case IV.—One of those cases in which the deciduous molars remained over the normal time, and were set low in the gums, was that of a boy whose teeth had never caused him any inconvenience, although the successors were about four years overdue. I extracted these firmly fixed molars, which had little or no roots, and the successors appeared soon after.

Case V.—Was that of a girl about fifteen years of age, for whom I advised extraction of the left upper deciduous lateral, because I was convinced by the slight fullness of the gum that a successor was present. It did not appear, however, for two years, but finally, after she had begun to fear that instead of a child-tooth an adult-tooth had been extracted by mistake, a feebly developed and partially grown lateral appeared, and in time took its place. The question may arise whether it was right to extract this tooth when I did. In my opinion, it was,—for the successor probably would have never appeared had the deciduous tooth remained until the absorption of the root had enabled it to fall out, a time which would not have arrived for several years. That the successor would have grown down in less time if the operation had been delayed a year or two is hardly probable, since it was seven years overdue at the time of its appearance.

Ought Adult Teeth to be extracted in Pairs? — Dentists also differ on this point, some stoutly asserting that they should be removed (especially the first molars), and others as earnestly maintaining that no such rule should be followed. For my own part, I incline to the retention of all teeth that are not overcrowded or extensively decayed, because it affords an opportunity to bring about more valuable results with less liability of causing the remaining teeth to fall away from proper antagonism. It is asserted that to leave more teeth on one side of the mouth than the other causes the face to become unbalanced in appearance. This may be true and it may not, as it depends upon the position of the teeth. Many dental arches are unevenly balanced, one arm of the arch being longer than the other, because the corresponding teeth of the two sides are not directly opposite. If the posterior ends of the dental arch are directly opposite, and the teeth are on the line, and are not jumbled, then the presence of more teeth on one side than the other may cause a greater fullness on that side of the mouth; but when one arm of the arch extends back, beyond the other, sufficiently to offset the difference in the number of teeth, a variation in the outline of the anterior portion of the dental arch and face is seldom noticed. The extraction of teeth whose removal will permanently benefit the patient, and no others, would seem to be the best practice.

CHAPTER LXIV.

EXTRACTION OF DECIDUOUS TEETH, TO PREVENT IRREGULARITIES OF FORTHCOMING LATERALS, CUSPIDS AND BICUSPIDS.

DIFFERENTIAL TREATMENT OF UPPER AND LOWER JAW.

AS briefly mentioned in the last chapter, there is a possibility of causing irregularity by premature extraction of deciduous teeth. As the understanding of this matter is important to the beginner, and such possibilities are liable to occur (for instance, in cases where the deciduous cuspid of the upper jaw is removed to relieve overcrowded incisors before the first bicuspid has made its appearance), the subject will now be dealt with in detail.

As this tooth (first bicuspid) generally erupts several months before the cuspid, it is very liable to move forward and encroach upon the territory belonging to the cuspid, so that when the latter (the cuspid) erupts, it stands in the anterior position.

Of course, as a rule, the aim should be to manage the case so that the six front upper adult teeth when they erupt shall all be saved and stand in line, if possible; but, to obtain this result, it may be necessary to deal harshly with some of the teeth posterior to them, but which teeth should be so dealt with is sometimes a nice point to decide. With the lower jaw, however, the difficulty of decision is less; for the removal of one of the adult incisors when they shall have erupted will generally make sufficient room, and the loss is seldom noticeable. The centrals which erupt first are less frequently found to be irregular than the laterals, and when malposed easily correct themselves soon after the crowns of the deciduous laterals fall and before their successors erupt. When there is but slight irregularity of the adult lateral, sufficient room may generally be gained by grinding away a small portion of the "cheek" of the crown of the deciduous cuspid; but, if the irregularity is excessive this will not suffice, and something more radical, (as, for instance, extraction of the deciduous cuspid,) may possibly become necessary.

In the lower jaw, the adult cuspid usually erupts first; the first bicuspid next; and after this, the second bicuspid, thus differing, as before said, from the order of eruption of the upper teeth. Here the (upper) first bicuspid usually appears first; the cuspid, second; and the second bicuspid, third. In either of these cases, if the only point to be regarded is liberation of the overcrowded lateral, the extraction of the deciduous cuspid alone would be proper, but by it there would be liability of a great danger, *viz.*, the encroachment of adjacent teeth upon the territory, which I will now proceed to explain differentially. If the *lower* deciduous cuspid should be extracted before the time of eruption of the successor, the correction of the irregularity of the incisors would, by the encroachment upon the space or territory of the cuspid, prevent it (the adult cuspid) from fully taking its place on line between it (the incisor) and the first deciduous molar. In the case of the upper jaw, the eruption of the first bicuspid, occurring as it does before that of the cuspid, it (the bicuspid) would be liable to encroach from the opposite direction upon the territory left open by loss of the deciduous cuspid ; and this, added to the encroachment of the liberated irregular incisor, might entirely close the gate to the adult cuspid. But, if teeth in the lower jaw are found arranged in this manner, there is a temporary remedy through the extraction, additionally, of the first deciduous molar, or, if in the upper jaw, of one of the bicuspids; but, if an upper deciduous cuspid must be prematurely extracted, to liberate an irregular lateral, prudence would suggest that when the first bicuspid has not erupted it is safer to extract also the first deciduous molar at the same time, in order that the successor (first bicuspid) may, by having sufficient room, be permitted to erupt on its own territory. This renders the bicuspid less liable to move forward on that of the cuspid.

In many cases the same suggestion is applicable to the lower jaw; for then (by the extraction of the first deciduous molar) the adult cuspid of this jaw, like the adult cuspid of the upper, by having comparative freedom, would move along and be prevented in most cases from erupting outside of the (adult) lateral. Should this treatment subsequently fail to make sufficient room for both the cuspid and first bicuspid (in the lower jaw), there is one more way out of the dilemma, through the extraction of the second deciduous molar, which being considerably larger than its successor (the second bicuspid), there would be space to spare, which, in most cases, would be sufficient for the cuspid, first bicuspid, and second bicuspid, to take their proper places in line.

In fact, it may be said that if the second deciduous molar is allowed to remain, the latter by its large size sometimes guides away the first bicuspid in its process of eruption so that it will incline too far forward. Owing to the same circumstance, the second deciduous molar sometimes even presses the first bicuspid against the partially erupted cuspid, leaving the latter to wedge and work out its eruption off against the bicuspid and lateral, as best it can, and causing by this action a crowded, even jumbled arrangement of all three teeth.

For several years, I have been more and more inclined, contrary to the usual custom in treating cases of this kind, to clear the track (for the adult teeth), for the time being, by extracting deciduous teeth that stand in the way of the orderly eruption of the successors, keeping watch of them through the period of the eruption of the cuspids and bicuspids. If, at that period, there is not sufficient room for all three, and if enlargement of the dental arch to let them into line is not advisable, and the first adult molar is sound, I then extract one of the bicuspids. But, as this plan requires careful watching, considerable experience and some boldness, it is not urged upon young practitioners. I would, however, suggest that when an upper lateral incisor is so overcrowded that it becomes necessary to extract the deciduous cuspid, it is well to consider the question of extraction of the first (deciduous) molar at the same time or as soon as there are the least signs of approaching eruption of the first bicuspid. The second molar should remain.[1]

The propriety of extracting one of the bicuspids to prevent or do away with overcrowding, in a large proportion of these cases, has grown more and more apparent to me; but, as before said, of course this should never be done without deliberation as regards facial expression, which may indicate enlargement of the arch, thus requiring the presence of all the teeth. Thus it becomes evident that if there does not appear to be sufficient space between the adult lateral incisor and the first adult molar for the adult cuspid and the two bicuspids, the question is, what to do, —not what to omit doing.

In regard to the extraction of deciduous molars, however, the importance of retaining sufficient masticating apparatus to maintain digestion until about the time for the eruption of the new teeth (bicuspids), must be apparent to all, *i. e.*, if the first adult molar, on account of advanced decay, should

---

[1] See note on page 680.

be unfit for mastication, the patient might suffer from indigestion before the bicuspids could have time to erupt sufficiently to be useful. In such a case the decayed adult molar should, as a general rule, be preserved by filling until the bicuspids attain their full growth, unless the eruption of the bicuspids should be so tardy that there are strong indications of immediate eruption of the second molar before, when, if the first molar is too defective to be of lasting value, it should be extracted in order to let the second molar move forward and take its place, during which time the child should be fed upon comminuted food.[1]

---

[1] NOTE.—To avoid any misunderstanding on this point, it may be well, in conclusion, to explain further the suggestions advanced on the preceding page as to grinding deciduous cuspids to make room for slightly irregular laterals, as also for not extracting second deciduous molars, for it might be thought that the gain by either procedure would be counterbalanced by defect elsewhere. If there is not sufficient room for a lateral to stand in line it is possible that space enough may be made in time by growth of the jaw, but this is too rare an occurrence to be depended on for correction. But it might be thought that to grind the deciduous cuspid would deprive the adult cuspid of some of its territory. This objection is not valid, because the portion taken is made up by the extraction of the first deciduous molar, if of the lower jaw, or the first bicuspid, if of the upper (in case the former plan is followed); or, if the latter, by the extraction of the second deciduous molar, which is larger than its successor. To make room for the lateral is quite as important as to make room for the cuspid, and there is no better time to do so than before eruption of the cuspid. Regarding the preservation of the second deciduous molar until the second bicuspid is ready to erupt, the object is to prevent the first adult molar from moving forward on the territory of the bicuspid, which would deprive the cuspid of the benefit of the space derived from the difference between the size of the second deciduous molar and that of its successor, the second bicuspid.

CHAPTER LXV.

THE FIRST ADULT MOLAR.

VIEWS OF OPPOSING PARTIES CONCERNING ITS EXTRACTION. —FIRST MOLAR VERSUS THE BICUSPIDS.

WE have now come to the question of the value of the first molar. No tooth has been the subject of so much discussion as this one, which erupts at about the sixth year of life, and is sometimes called the "sixth-year molar." Although its germ really belongs to the deciduous set, this tooth is generally classed with the second set, and becomes a "permanent" tooth if properly taken care of; therefore, for brevity, it will be called an adult molar.

Two radically different opinions exist as to the disposition of this tooth. It is asserted that Webster once said that "the greatest evidence of the genuineness of Christianity lies in the fact that it has survived for nearly 1900 years in spite of the pulpit." So it may be said that the great value of the first molar asserts itself by the profession, as a whole, allowing it to remain in spite of the heated discussions concerning it.

The first molar has the largest grinding surface of any tooth, therefore its value for this purpose cannot be disputed; but, as it erupts at so early an age, before any of the other so-called "permanent" molars, it is generally supposed by parents to be of temporary duration. Accordingly, like the falling teeth, it is neglected, and often allowed to decay beyond possible salvation. This is probably the main fact in which the question of its usefulness originated. As in the case of all warmly disputed questions, emphatic views are entertained upon both sides. It is probable, however, that if the views developed in such discussions were more calmly expressed, and "more respect were shown for the opinions of others, greater progress would be made in the settlement of this as well as of other questions."[1]

Views of Opposing Parties.—Some dentists argue that whether the first molars are decayed or not, the space they occupy is more desirable than their presence, as the remaining teeth will be less crowded in their absence and therefore less liable to decay. The other party takes the opposite ground, namely, that as the first molars are regarded as a part of the second set, they should be preserved, because their removal would break the continuity of the antagonism, and also that it would be a violation of nature; because, if these teeth were not intended to be retained, they would not have grown there. Thus the disputants go to extremes, one class advocating the entire destruction of these teeth, and the other their salvation at any cost.

It appears to me that there is really but little cause for these acrid discussions, and that the problem can be easily solved. If the tooth is comparatively sound, it is valuable for masticating purposes, and should not be extracted, except, perhaps, in rare cases, to make room for overcrowded cuspids and bicuspids. Even this argument fails when the value of this tooth is compared with that of a bicuspid, which may be extracted instead and serve the same purpose; liberation. On the other hand, if the first molar is

[1] "Courtesy among Dentists," an oration by the author, delivered before the American Academy of Dental Science, Boston, Mass., Nov. 10th, 1886. "Independent Practitioner," Feb. 1887, p. 71.

badly decayed or is pulpless, and so degenerated generally that it is impossible to preserve it for any considerable time, its disposal should be determined by these circumstances. As this tooth is admirably calculated by its timely appearance to assume the duties of the lost deciduous molars during the interim in which the eruptive process of the bicuspids is in progress, it should, even if considerably decayed (if not causing severe and incurable pain), as before said, be preserved to masticate with, until the bicuspids are able to perform this duty, unless it is evident that there is not sufficient space for the eruption of the bicuspids in line.

The circumstances above referred to concerning the first molar are briefly as follows: As the bicuspids generally are in place before the appearance of the second molar (which erupts at about the age of eleven or eleven and a half years), if the first molar is extracted at this time the second molar or so-called "twelfth-year molar" will generally move forward bodily during its erupting process and take its place. But, if not extracted until after the second molar has taken its place behind the first, a sufficient forward movement of this tooth cannot be depended upon; and when partially successful it is as likely to be from the tilting over of the crown as from a movement of the tooth bodily,—in fact more so. This tilting also generally causes imperfect antagonism.

These statements apply to extreme conditions, but between these extremes there are all degrees, of which the variations render the settlement of the question more difficult. Since some of these teeth should be extracted and others saved, it naturally follows that there must be a dividing line between those which should be condemned and those which should not. There are conditions of marked defect, which even a tyro cannot fail to see renders the tooth worthless; for instance, when the crown is wholly decayed before ten years of age. Even if the crown is partly decayed, its salvation might be regarded as possible only for a brief period, especially if the socket is diseased. Again, as before implied, although the tooth may appear comparatively sound, the general structure may be so imperfect that it can be preserved for only a few years at most. In these cases, for the ultimate benefit of the patient, especially when the bicuspids are overcrowded, it will be best to extract such teeth.

First Molar versus Bicuspid.—If these premises are sound, it will be seen that so far as regards the question of extraction, there is after all not so much debatable ground as would appear at first. There is considerable difference of opinion in cases where the dental arch does not require enlarging to make room, and yet is overcrowded, so that it becomes necessary to decide between the extraction of a slightly decayed first molar and a sound second bicuspid. When the relative length of life of these teeth is considered, I think that notwithstanding the later development of the bicuspids, their perishability is so great, and their value as masticators is so much less than that of the molar, that the forceps should fall not upon the larger and more valuable molar, but upon the less valuable second bicuspid. There is another point, however, that should be regarded —namely, the condition of the first bicuspid; for if this tooth is decayed and the second bicuspid is sound it may be better to extract the former and move the latter forward into its place.

In rare cases, it is found that if all the first adult molars are extracted before the eruption of the bicuspids, especially if their predecessors (the deciduous molars) are present, and are so defective as to cause pain, when used for mastication, the child will use the anterior teeth for molar purposes; and if this is continued for a considerable length of time, the bearing of the lower teeth against the upper is liable to force them forward and in turn force the lower backward. Besides causing overcrowding of the lower front teeth, this displacement will make the upper teeth protrude, sometimes separating them so that they will appear scattered. If, however, the first adult molars are extracted after a late appearance of the bicuspids, even before their full eruption, this injury may not occur, especially if the first (molar) is extracted only a few weeks before the time of eruption of the second (molar), because the latter will so soon take the place of the former that it will furnish sufficient bearing to prevent a forward movement of the jaw from becoming habitual in the effort to antagonize the lower teeth. Prudence, however, suggests that to prevent this habit it is important to preserve, if possible, sufficient bearing at the sides of the dental arches to obviate the necessity of chewing with the anterior teeth. This may often be accomplished by the temporary use of caps or plates.

The roots of decayed first molars are frequently found remaining in their sockets long after the eruption of the

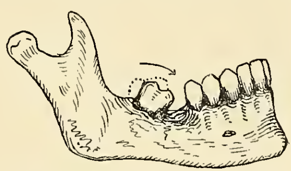


FIG. 653.—Inclining forward of a second Molar.

second molar. To extract these may be necessary for the relief of pain, but such late extraction is liable to be followed in time by the falling forward of the second molar as shown in Fig. 653. To prevent this, such roots, if they are sound, may be preserved for several years by being filled and crowned; sometimes, however, the falling forward may be prevented by increasing the strength of its lock in antagonism by grinding. If this is accomplished, the roots of the first molars may be extracted. Occasionally it is better to extract the posterior root to give the second molar a chance to move forward bodily, if disposed to do so, without danger of its inclining too much.

When a first molar is lost, the adjacent tooth is not only liable to incline forward, but others behind it sometimes incline also. Nor is this all, for these teeth, owing to the change of antagonism, are in some cases, as pointed out by Dr. Davenport of Paris, found to have turned partially around in their sockets. It will be seen, therefore, that although the extraction of a tooth may relieve pain, it is possible that it may lead in the end to a far greater annoyance than toothache, for pain can be remedied in most cases, but broken antagonism is difficult, sometimes even impossible to correct. If the responsibility resting upon the dentist as to judicious extraction were clearly understood, how much more apparent would be the evil of the ruthless waste of teeth as practised by charlatans, who live not by their services in saving teeth, but by making cheap artificial substitutes. Much more might be said upon the question of extracting in general, but unless it bears upon the subject of this work it would be irrelevant. As to extraction for the purpose of relieving pain, as has been said, there are cases in which it is necessary; others when it is giving temporary relief (which might be otherwise obtained) at the cost of a permanent annoyance and possible impairment of health, for together with the evil of disturbed antagonism by the inclining of teeth the loss of one tooth is practically equivalent to the loss of two teeth.

Thus again, it becomes apparent that any fixed rule of action in the matter is less advisable than no rule at all.

It is probably better to point out general principles, and then leave the judgment free to be governed by surrounding circumstances, than to hamper it by multiplied instructions. To do that which seems best for the permanent benefit of the patient should be the aim of the operator. Of course, this leaves room for diversity of opinion, possibly leading to mistakes, but that does not alter the fact that freedom of judgmeut is quite as likely to lead to better average results, as would the adoption of fixed rules. There is always one best way in every given case, and trained common sense is generally able to discern it. Mistakes will probably occur; but the fixed maxims of hobbyists paralyze reason and judgment, and cause at least as many errors as would result from independent decisions.

To show the importance of careful examination of the condition of the teeth that have erupted, and of ascertaining the probable positions of the teeth that have not erupted, the consequences of premature extraction of deciduous teeth, and the remedy by extraction of the first adult molars, the following cases are given:

Case I.—Molars extracted to make Room for Cuspids.—In the Ohio State Journal of Dental Science,[1] Dr. George W. Keely reports a case that illustrates the question of extraction of all the first adult molars, a method of practice that may be called heroic. In this report he prefaces his remarks by saying substantially "that he has never seen a case where he would remove all of the first molars, if all were sound and healthy. But, if one or more were badly decayed, and the patient should be under fifteen years of age, the matter would be different; that often the removal of a molar from one side will cause the anterior teeth on that side to fall back, and greatly mar the contour of the features; therefore, in cases of patients under twelve years of age, with the anterior teeth much crowded, the first

[1] May, 1885.

molars being defective, and where there is a question as to saving them permanently, it is proper practice to remove them." This statement appears to imply the possible advisability of extraction in pairs, if not in double pairs, in order to prevent facial injury by the falling back of the anterior teeth of one side, a phenomenon which, within my observation, has not proved to be of sufficient importance or frequency to warrant making this a rule of action.

Fig. 654 illustrates this case of a girl of twelve years of age. "As the first lower molars were not only badly de-

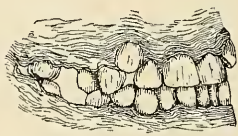


FIG. 654.—An Overcrowded Cuspid (Keely).

cayed and accompanied with abscess, the extraction of the four first molars seemed to be indicated; therefore they were removed. The figure shows the appearance a few days after the extraction; the upper cuspids stood outside the line of the esthetic arch, the lower anterior teeth crowded; and the four second molars just beginning to make their appearance." Further reasons given for the extraction of the four adult first molar teeth are, that while the first upper molars were less decayed, and could have been saved, their salvation would have necessitated the enlargement of both arches, which, with the two pulpless lower teeth above-mentioned, would have been a slow and difficult operation.[1]

[1] "Ohio State Journal of Dental Science," May, 1885.

In a short time the second molars began to move forward so rapidly that it was found necessary to hasten the backward movement of the bicuspids by art, in order to make room for the outstanding cuspids to fall into line. This was accomplished by the aid of wedges made of compressed pine-wood.

Nothing further was done except to restore the antagonism, which was brought about by the use of a vulcanite plate, made so as to bear hard on the lingual walls of the bicuspids to move them outward about one-eighth of an inch.

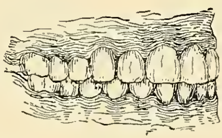


FIG. 655.—The Case after Correction.

Fig. 655 illustrates the case as it appeared two years after the molars were extracted. This shows that both the upper and the lower teeth were in line, and that the second molars and second bicuspids came in contact without inclining the former.

To liberate an imprisoned Bicuspid.—Case II., which was referred to me by a professional friend, was that of an imprisoned bicuspid in a girl of about twelve years of age. The two right upper child-molars and cuspid having been prematurely lost, the first adult-molar had moved forward into the territory left by the second child-molar, and belonging to the unerupted second bicuspid. The first bicuspid had erupted, however; but had not only straggled forward a short distance upon the territory of the unerupted adult cuspid, but also stood turned one-fourth around. The space left was not sufficient for the (adult) cuspid, but there was a small space remaining between the bicuspid and (adult) molar, which, if the bicuspid should be moved back against this molar, would make room enough for the cuspid. But this would leave no room for the second bicuspid should it be present beneath the gum (see Fig. 656). To make room for the cuspid, there had been this attempt to force the first bicuspid back against the molar. There had also been an effort made to turn this tooth. The aids used were of elastic rubber attached to a hard rubber roof-plate, but after

Fig. 656.—Imprisoned Bicuspid.

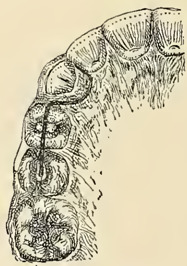


Fig. 657.—Bicuspids retained in place by Wire.

Fig. 658.—Appearance of Retaining Wire.

the bicuspid had moved a short distance it stopped and would not further respond to any force applied. This was the condition of affairs when the case came into my hands. An examination with a needle probe through the gum between the (first bicuspid and the molar) teeth proved that the cause of the difficulty was the unerupted second bicuspid. The situation demanded bold work. The plate and elastics were removed, and as the first molar was far advanced in decay, it was extracted; thus making room for the imprisoned bicuspid. At the same time the lock in the antagonism with the opposing tooth, which held fast the first bicuspid in the wrong place, was ground out (with a corundum-wheel), when the case was suspended for several weeks to give nature an opportunity to correct the irregularity by moving the second bicuspid back as far as possible. The bicuspid did not fall back sufficiently, however, to make room for the cuspid, because of the unerupted second bicuspid. To attain this end, therefore, it was drawn back by a gold clamp-band, placed around it and the second molar as anchorage, and tightened with a screw. This backward movement of the first bicuspid forced the second bicuspid along into the place of the extracted molar (before it erupted). This being attained, the second stage of the operation was completed, and the case was again suspended until the cuspid should appear.

After several months the cuspid also came forth, and as there was left sufficient room for all the teeth in the arch without turning the first bicuspid, it was, at the request of the child's father, allowed to remain in the position in which it was first found. The second bicuspid had also taken its place.

To prevent the first bicuspid from falling forward again upon the territory of the cuspid while it was coming down to place, one extremity of a piece of gold wire, having two arms soldered to it, was anchored with cement into cavities in the antagonizing surface of the two bicuspids, while the other extremity of the wire which curved around the lingual side of the cuspid territory rested against the posterior approximal surface of the lateral incisor, as shown in Fig. 657.

This delicate wire fixture, which I denominate a sickle retainer, from its resemblance to a farmer's sickle, was worn for nearly a year without inconvenience. Fig. 658 is a side view of this retainer, showing the shape of the anchor arms and their relation to the device.

CHAPTER LXVI.

CUSPID VERSUS LATERAL.

EXPRESSION OF TEETH.—THEIR RELATIVE ESTHETIC VALUE. ROOTS OF CUSPIDS AS SUPPORTS TO FACIAL CONTOUR.

THERE are instances in which the upper front teeth are crowded and even jumbled, and at the same time the lips are full and prominent, so much so that to widen the arch sufficiently to make room for all the teeth in line would impair the symmetry of the face. What to do under such circumstances is a question interesting to students.

In 1878, in a college lecture on extraction, I mentioned that, although I might be in the minority, and even almost alone in my opinion (at that time), and although much might be said in favor of cuspids, I thought that the sacrifice of a lateral incisor to make room for an outstanding cuspid was objectionable, esthetically speaking. This view, which was referred to in the previous chapter, I now hold more firmly than ever; for, according to my opinion of what contributes to attractiveness in facial expression, the salvation of all the upper incisors is the only way to preserve it, nor do I think that, from this point of view, the cuspid is less valuable.

In the arts of painting and sculpture, although some general laws of proportion and color have been accepted, no well-defined indisputable rules are laid down as to the application of these laws; and if this be so in creative work, how much more difficult it would be to make set rules to govern the ever-varying conditions presented when the effort is to effect the highest possible degree of improvement in that which already exists. It is, however, possible to point out some general principles that may assist the beginner. In order to simplify the question, it will be treated under different heads; first, the value of the cuspid in preserving the contour of the face; second, the relative esthetic value of the cuspid and the lateral; and, finally, the relative value of the cuspid and bicuspids.

Individual Expression of the Teeth.—Teeth have an individuality of expression in their shape and size; although that of some teeth is not visible, all have more or less. Of the ten front upper teeth, the incisors and cuspids appear to

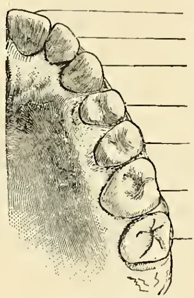


FIG. 659.—Dental Expression (A).[1]

have the most, because they are most conspicuous. These are all feature teeth, and if one of them should be lost, and there is no substitute resembling it in appearance, there would be a defect sufficient to mar the facial expression. The lower incisors, however, are so nearly of uniform size and shape, that if one is missing the loss is not so noticeable. The expression of all the teeth is approximately explained in what may be termed a system of dental expression (see Fig. 659).

[1] First given in a lecture by the author, delivered in Dental College, Baltimore, Feb. 1878, and in Philadelphia, the same year.

As applied to the upper jaw, this may be read as follows:—

Central Incisors	Intelligence.
Lateral Incisors	Refinement, gentleness.
Cuspids	Firmness, courage, ferocity.
Bicuspids	Moderation, conservativeness.
Molars	Power.

The same theory applies to all the lower teeth, except the central incisors, which, being nearly like the upper laterals, have a similar expression, but which also correspondingly harmonize with that portion of the face below the mouth.

Application.—When we consider how much narrower the upper laterals are than the centrals, it is easy to see that their presence has a refining effect upon the centrals. This is made more apparent by imagining what a coarseness of effect would be produced if all the upper incisors were as broad as the centrals and cuspids, or if the lower incisors were as broad as the upper centrals. This also applies to the bicuspids, which, by standing between the sharp cuspids and the strong, millstone-like molars, modify the expression of both.

Much might be said about the change wrought in the cuspid by evolution, which has probably brought it into line from a prominent anterior position where it once formed an angle in the dental arch, and has reduced its uncouth size (from that which was necessary to the tearing of meat food) to its present dimensions. Under modern conditions of life, the cuspid fulfils only the same functions as belong to the incisors. But it is unnecessary to enlarge on this subject further than briefly to show the power of change of condition and habits in the moulding of form. Those of my readers who desire to study these interesting scientific questions are referred to the various works of the authors mentioned below[1] and to those of other writers on Evolution.

Relative esthetic Value of different Teeth.—Of the Lateral Incisor.—Dr. N. W. Kingsley says: "A pair of any of the teeth in the mouth may be removed to correct an irregularity, excepting the canines of both jaws and the superior central incisors."[2] He further says: "It would be an inconceivable case which would justify the extraction of the superior central incisors; but the upper lateral incisors and any pair of the lower incisors may be removed in certain cases without serious detriment to the appearance of the mouth."

While I coincide with some of Dr. Kingsley's views on regulating teeth, I cannot agree with his statements as to the relative value of the teeth in question. My views are more in accordance with those of C. A. Harris, *i.e.*, that "they" (the laterals) "should never be removed unless their arrangement and that of other teeth are such as to render their adjustment impossible" (1850). I think that if a cuspid should erupt off against the lateral, the first bicuspid being in contact with the lateral and standing on line with it, leaving no room for the cuspid,—then (if the conditions of the case will not permit the moving of the cuspid into the place of an extracted bicuspid) the loss of the cuspids would be less noticeable than the loss of the laterals. If the first bicuspid be reshaped so as to resemble a cuspid, it will fairly represent the latter in esthetic value, although there would be perhaps a slight variation in its shape and shade and possibly a slight "flattening" of the alæ region.[3]

The operation by this method is easy compared with that of substituting the cuspid for the bicuspid, or of enlarging

[1] Häckel on "Generelle Morphologie," 1866, B. II. S. clv.; Owen on "Anatomy of Vertebrates," 1868, Vol. III., p. 323.

[2] "Oral Deformities," 1880, p. 54.

[3] The author's reasons for this statement were made public ten years ago in a lecture at Pa. College of Dental Surgery (1878), and also in the "Dental Cosmos" in March of the same year, Vol. XX., No. 3, page 149.

the arch so as to make room for all the teeth in line, which might ruin the antagonism; but, as stated already I do not regard it as in accordance with the highest art, although it may be the best under the circumstances in some cases. If the lateral stands posterior to the esthetic line, it may generally be forced into position by the use of mechanical devices. There is a degree of malposition of the lateral, however, that may possibly render its extraction admissible, especially if the patient be of the class to whom appearance is of little importance. Sometimes one front tooth crowds upon another in such wise as not only to force the crown of the tooth out of place, but the apex of its root also. In such a case the management of the lateral is more difficult than of the cuspid, because they generally have a corresponding action upon each other, and this often being approximately in proportion to the size of the teeth, sometimes gives the cuspid the advantage, and the lateral is crowded far into the posterior position.

For illustration, when a cuspid erupts outside of the lateral, the latter not only tends to prevent the former from placing itself in proper line, but the cuspid also forces the lateral bodily inward so far that even if the arch be enlarged enough to allow the crown of the lateral to fall into line, the apex of the root lies at such a distance from the esthetic line that if the crown of the lateral should be brought into it by the usual method (inclining), the degree of inclination outward might be so great as to appear unsightly. (See position of tooth B, changed to dotted line D, Fig. 660). If, however, the lateral can be moved outward bodily (as I know from practical experience can be done by proper apparatus), then the case is different, but this method frequently presents difficulties.

If the esthetic value of the six upper front teeth is as great as above represented, it is evident that if one must be sacrificed, it is better to extract the one that can be esthetically replaced by an adjacent tooth. This can only be the case with the cuspid. The circumstances, however, are rare indeed that would, for scientific reasons, call for loss of the cuspid, as one of the bicuspids, or even the first molar, especially if defective, could better be spared than teeth of such high esthetic value; therefore, I do not wish to be understood as urging the extraction of the cuspid, but I regard it an extreme measure to be tolerated under extraordinary circumstances. It is a matter, however, on which

FIG. 660.—Showing the effect on the Lateral, B, of the crowding of the Cuspid.

it is well to deliberate; for even if the lateral stands far to the posterior of the esthetic line, if the widening of the arch is necessary to fill out the face properly, it would be better after the enlarging process and the partial movement of the laterals, to leave it then to nature, which in time will often (if antagonism does not prevent) move it outward sufficiently to render the defect unnoticeable. To advise extraction of instanding laterals on the ground that "their absence will not alter the appearance of the individual because hid behind the cuspid and centrals already in contact," is, I think, evidence of want of taste, to say the least.

The Roots of the upper Cuspids as Supports to the Contour of the nasal Region of the Face.—Before continuing the discussion of the question as to which teeth to extract, let us consider the value of the cuspid as a support to facial contour. Of course, it has always been a palpable fact that when all the teeth are lost, the middle portion of the face falls in, and the end of the nose drops. It has also been noticed that if the upper cuspids alone remain, the alæ of the nose do not fall quite as much as when they are lost. This has given rise to the statement generally accepted and promulgated by some writers that under no circumstances can these teeth be lost without causing this disfigurement; and that, if either the cuspids or laterals must be extracted in regulating teeth, it should be the latter. Those dentists teach that not only should the cuspid be preserved at all hazards, even at the expense of the lateral, to maintain the contour of the alar region, but, because the cuspids are stronger and more durable than the laterals, they are vastly more valuable. This implies that the laterals are always lost before the cuspids, which is not true.

Fig. 661.—Showing Facial changes between 19 and 65 years of age, occasioned by the loss of the Upper Teeth.[1]

Fig. 661 illustrates (by plain lines) the profile of a face at nineteen years of age and before the loss of any teeth, and (by dotted lines) the same profile many years after all the upper teeth were lost and artificial ones had been substituted.

[1] Profile of R. P. F.

If the points above alleged (in support of the preservation of the cuspid in preference to the lateral) were proved, they would be sufficient to justify the claim of their extreme importance, but facts show that they are not, under all circumstances, worthy of the consideration claimed for them. Admitting that the durability of bicuspids which have been made to take the place of extracted cuspids is not always equal to that of the latter, yet the normal contour of the face when all the remaining teeth are present and in contact (unless occasionally in some small degree near the alæ of the nose) would be maintained. Even a possible shortcoming in this direction may sometimes have a favorable side; for if the original contour of this region be too full, and it should fall a trifle, it would be an improvement. So it is with the nose itself; although the loss of the cuspid may possibly though rarely cause a slight fall of the alar region and a corresponding droop of the nose, so often seen to a remarkable degree in aged people who have lost all their teeth, yet if the nose turns up, then the changes caused by the removal of the cuspid may be beneficial, because the nose might appear straight, and the alar region be reduced a trifle, and both together have a balancing effect that would improve the face.

But in practice these impairments and improvements are often so slight, where the dental arch is quite full, that in many cases they are hardly worth noticing; for, if the cuspids be extracted, the region about the nose would only be slightly affected either way. In brief, it may be stated that to attain the best results from regulating teeth, due regard should be had for their arrangement so as to secure not only a harmonious balance about the nose, but of the lips and cheeks with those features that are more permanent, such as the forehead, eyes, and zygomatic regions. As in substituting a partial denture for a few lost teeth, the artistic dentist is not always governed by the former contour of the lips, etc., so it should be in the regulating of teeth.

Admitting the cuspids to be stronger and occasionally more durable than laterals, neither the nature of food used

FIG. 662.—Showing the esthetic Effect of the Presence of Laterals alongside the Centrals.

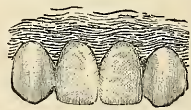


FIG. 663.—Showing the coarsening Effect of substituting Cuspids for Laterals.

at the present day nor the customs of society call for such use of the cuspids as the tearing of meat from the bones. Why, therefore, on the ground of strength, should the cuspid be substituted for the lateral, and allowed to stand beside the broad central, giving a coarse and carnivorous expression to the mouth, as it will do, without the refining influence of the lateral incisor? (See Figs. 662 and 664.) There is no substitute for this influence, and, therefore, while I admit that the extraction of a lower incisor may be allowable, even advisable, in some cases, because they are all of nearly the same size and shape, it seems to me to be seldom proper to extract an upper lateral (Fig. 663).

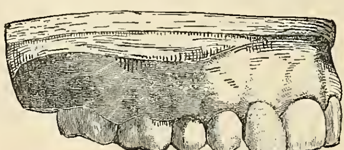


FIG. 664.—Side view of the Upper Teeth showing the Violation of Esthetic Effect by the presence of a Cuspid in place of an extracted Lateral Incisor.

The loss of a lower incisor is seldom noticed, but, of course, if by it the arrangement of the side teeth would be impaired in the course of time by the narrowing of the (lower) dental arch in consequence of the antagonism of the upper, then such extraction would not be proper, but upon this point, as regards lower teeth more will be said in another chapter.

I have read of an operator who had, for several years, made such a practice of extracting upper laterals to make room for overcrowded cuspids that some people said that they could readily point out his patients wherever seen, by the facial deformity caused by throwing these large teeth so far forward, a deformity which was not confined to the appearance of the crowns in the wrong place, but which placed the prominences of the socket walls caused by the large roots too far under the nose. This criticism may be exaggerated, but that deformity can thus be caused there can be no doubt.

I have known a dentist of this opinion to extract for his own daughter the upper lateral incisors to make room for overcrowded cuspids. The daughter, when grown up, was obliged to wear artificial substitutes for the teeth which her father had extracted. The space occasioned by their loss, being narrower than the original teeth, made it necessary to use narrower substitutes, but this (esthetically regarded) was better than to close the gaps by drawing the cuspids and centrals together, a procedure of which I have seen several instances. For another illustration of this kind of practice, a young lady who had lost both of her upper laterals by extraction several months before, came to have her teeth regulated because they were still very much overcrowded and jumbled. Upon being asked why she had the laterals extracted, she said, "Some of them had to be taken out, and the dentist said these were the smallest teeth in the jaw, and were not of much account."

To reiterate, the best practice is to preserve all the (upper) incisors and the cuspids also, sacrificing, if necessary, some of the bicuspids, unless the position of the root of an incisor, the state of the crown, and the condition of the socket render it impossible to do better, or unless the patient is of such a class that an attempt to carry out artistic excellence would be absurd. Even if the durability of the cuspids should be greater (which is not always the case), that fact would not, in my opinion, constitute a valid reason for disfiguring personal appearance for half a lifetime or more by extracting the lateral. I never extract an upper lateral or central, and never sacrifice the cuspid if the circumstances of the case permit it to be saved. (See last paragraph of next chapter.)

Of course, this is a question solely of esthetics, but it is of so much importance that I cannot treat it lightly. What is applicable to natural teeth in this matter is applicable also to artificial teeth. What would be thought of the judgment of a dentist who would assert that cuspids may be substituted for the upper lateral incisors in an artificial denture "without serious detriment to the appearance of the mouth?" The error of such an opinion is so evident that I cannot believe that Dr. Kingsley really meant to fully assert what his statement would naturally be understood to imply.

However displeasing may be the effect of placing a cuspid beside a central that is on the same side of the median line, it is not so unsightly as that resulting from the extraction of a central, even though the lateral may be left as a substitute; but to extract both a lateral and central is much worse practice. Especially is this true, if they are crownable.

Not long ago, a case was referred to me by a dentist who had extracted a central incisor on one side and a lateral on the other, causing the remaining teeth to incline (noticeably) in different directions. Nor is this an isolated case; such blunders are more frequently made than is generally supposed.

Fig. 665 illustrates the appearance of another case, that of a woman of thirty years of age, whose left incisors had been extracted by a dentist, who, although a fair operator in other things, could see no breach of esthetic taste in removing this central and lateral to make room for an overcrowded cuspid.

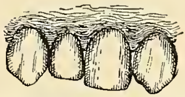


FIG. 665.—Deformity caused by extracting the Central and Lateral to make room for a Cuspid.

Exceptions.—We may, however, slightly qualify our remarks as to the influence of the laterals on facial expression by saying that they are not of equal importance in all cases; for instance, they are of more consequence to a woman than to a man with thick mustaches, and more important to people who go into society than those who do not. While, therefore, the statements made are strictly true from an artistic point of view, there are possible circumstances which might justify extraction of a lateral incisor. Again take the case, for instance, of a soldier on active duty in the field or wounded,—who cannot obtain the services of a dentist,—he might find it necessary to lose such a tooth to relieve some of his pain.

Such circumstances as poverty and humble condition may also afford sufficient reasons for waiving some of these points, and for extracting the lateral incisor, even though it would cause a coarseness of expression, because, on the whole, it would be for the best interests of the patient. Humanity would not permit that any one should be tortured with toothache, by refusing to extract when other remedies are out of the question. But to extract, when more artistic treatment is possible, would be, to say the least, questionable practice.

To some readers my views on this subject may appear heretical and my representations overdrawn; but they are not. We should aim to step out of the beaten track and appeal to higher conceptions of what constitutes the beautiful as well as the useful, and so aid in raising this branch of the science to what it is capable of being made. It seems to me that all lovers of progress should endeavor, not only to maintain and restore health through mastication and digestion, but also to modify the facial expression, so far as lies in the art of dentistry; changing it from that which is ugly and inharmonious to that which is attractive and pleasing.

CHAPTER LXVII.

IRREGULAR CUSPIDS AND INCISORS.—WHICH, IF EITHER, SHOULD BE EXTRACTED?

RELATIVE VALUE OF CUSPID AND BICUSPID.

HAVING considered in the previous chapter the esthetic question concerning the cuspid as compared with the incisors in the matter of extraction, more especially the lateral, pronouncing in favor of its retention rather than that of the cuspid, if either must be sacrificed, but preferring, whenever possible, the extraction of some tooth posterior to the cuspid, the attention of the reader is now called to the relative practical value of the cuspid and the bicuspid teeth.[1]

Probably no condition of irregularity is so frequently met with, and none requires more careful judgment, than that involving the disposition of outstanding cuspids of the upper jaw, for this question embraces not only the matter of the relative esthetic and comparative practical value of the cuspid and lateral, or of the cuspid and bicuspid, but also, in connection with the subject of antagonism, the decision whether any tooth should be sacrificed at all. As this phase of irregularity frequently occurs, and is puzzling to the student, it will be dwelt upon to a considerable extent.

---

[1] Same subject briefly treated by the author in the "Dental Cosmos," January, 1879.

While such a case as that illustrated by Fig. 666 plainly shows that extraction of the left lower second bicuspid would without doubt be the only proper course, there are

Fig. 666.—A case indicating Extraction.

cases such as that shown in Fig. 667, in which the indications are not so clear.

In this case, where one of the upper cuspids stands outside of the esthetic line and off against the point between the lateral and the first bicuspid, the lateral standing posterior to the proper line; the bicuspids and first molars (sound) being on the line; where the saving of all the teeth

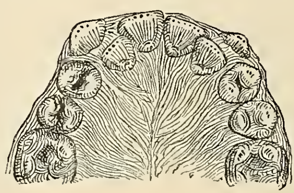


Fig. 667.—Which Teeth to extract, the Cuspids or one of the Bicuspids?

by enlarging the arch sufficiently to make room for the cuspids and laterals would cause the front teeth to protrude too far; and where, if one tooth on each side were extracted, and the others brought into line, a better effect would be brought about,—under such circumstances, which teeth ought to be extracted?

If the space resulting from the removal of the first bicuspid would be filled by the cuspid if placed in line, I would proceed to extract the first bicuspid; and then, if it appeared probable that nature would accomplish the correction, unaided, the opportunity would be given; unless the patient was opposed to taking chances, and wanted the teeth corrected without delay. If the delay were permitted, and after the lapse of a few weeks the cuspid and lateral did not take their places naturally, I would then compel them to do so. In this case, extraction is based upon the assumption that the apex of the root of the cuspid is so situated as not to incline the crown too much posteriorly, and that the position of that of the lateral will allow it to take its place in line. In either case, however, this degree of inclination of the crowns seldom occurs; in fact, the extent of the lateral movement of the entire tooth under such circumstances is often found to be surprisingly great.

If the removal of the first bicuspid would cause an unsightly space between the cuspid and second bicuspids after the teeth were corrected, I would extract the second bicuspid instead, and then force the first bicuspid back until there should be sufficient room for the cuspid and lateral to stand in line; because, if any gap must be left, it is better to have it located as far back as possible, so as to be less conspicuous. To more clearly illustrate my idea of the treatment of this variety of irregularity, based upon the principles explained in the preceding chapter (upon Expression of the Teeth), which is an estimate of the comparative esthetic value of different teeth, the following cases in practice are introduced. Before proceeding, however, there is one point that may be well to mention. It has been asserted that to move into line a tooth that stands directly outside of another would endanger the life of the dental pulp. This assertion has only a slight basis. While too rapid movement of any tooth for a considerable distance may endanger the pulp, slow and careful management will carry a tooth to a considerable distance without harm. It is not so much the danger of injuring the pulp that should be regarded in moving teeth, as it is their position and arrangement, and their chances of remaining corrected when once brought into line. Intermittent force is less liable, however, to injure the pulp than continued pressure.

Fig. 668 illustrates a case similar in appearance to that shown in Fig. 667, but permits of a different treatment.

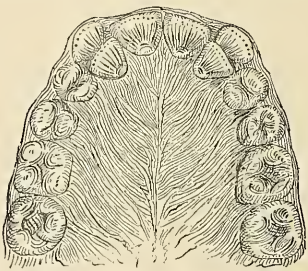


FIG. 668.—Which to extract, the Cuspid or the Lateral?

As will be seen, the cuspids stand directly outside of the laterals, which by their mutual influence are both forced from the esthetic line, one inside of it, the other outside. If it were necessary to force the central incisors forward in order to properly fill out the lips, there would still remain the question, as to whether sufficient room could be made between these teeth and the cuspids to let the laterals in. In the above case the laterals could be moved into line without inclining them so much as to be unsightly. But, if the laterals stand inside the line, as illustrated in Fig. 670, they might not, for, as before mentioned, the apices of the roots do not move so far as the crowns, and often remain comparatively stationary (see Fig. 669); but even this reason, as stated in a previous chapter, should not be regarded as conclusive, for by sufficient skill the roots of teeth can be moved.

When the apices of the roots of outstanding or instanding teeth are not too far to one side of the esthetic line, the question in these cases is easily narrowed down to the matter of deciding upon which teeth to extract. In my

FIG. 669.—Representing the Path of a regulated Tooth with stationary Apex.

opinion, aside from the point of malposition of the apex of the root, the decision of the question sometimes rests on the degree of soundness of the crown of the lateral, and on the sex of the patient. If the cuspid is on line, and the apex of the root of the lateral stands so far out of place that the crown if moved by tilting cannot be placed in line without inclining it so far as to be unsightly, the sacrifice of the lateral, leaving the cuspids in their places, may possibly be allowable; but even this I cannot concede without hesitation.

If extensive decay of the roots of the laterals exists, that might be sufficient reason for their removal, but if they are sound, their extraction might be highly improper, especially in the case of a woman, because, as already said, filling the place of a lateral with a cuspid causes a grossness of expression extremely detrimental to a feminine face. If the sockets are healthy, and the crowns decayed, the cutting away of the latter and the placing of artificial ones upon the roots, might be better practice than extraction.

In a man, as before said, the defect might be so hidden by a mustache as to be comparatively unnoticeable. Therefore in such a case as is illustrated in Fig. 670, unless the patient

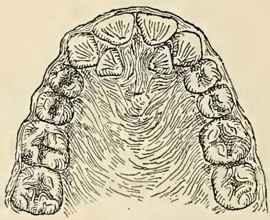


Fig. 670.—Which to extract, Cuspid or Lateral ?

is willing to submit to the more thorough operation of having the laterals moved bodily into place, they might be extracted and the cuspids moved toward the line. To improve the esthetic effect of the cuspids, they should then be made to resemble the laterals somewhat in form by grinding the points of the cusps, but even then their size would still be too large.

The appearance of cases that seem to render the extraction of the cuspid allowable is illustrated by Fig. 671, but while this might be permitted for a patient who could not afford to have the better operation performed, it would not be in accordance with high art.

When viewed from the profile standpoint, the incisors in this case require outward movements, as indicated by arrows. In these instances, when the patients are more than eighteen years of age, I either draw the incisors into line by tying them to a gold long-band extending around the arch, and anchored to the side teeth, as shown in detail in Fig. 681, or force them out by radial screw-jacks, tack-head

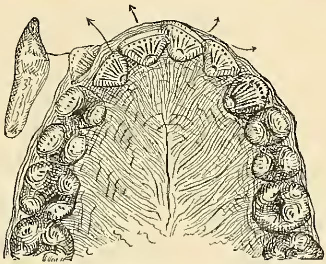


FIG. 671.—Case of Extraction of a right Cuspid.

tail-jacks fixed to a plate, springs, or by small metallic inclined planes fixed to U-shaped wire anchored to molar clamp-bands. Wire arms for elastics anchored to plates are also used in various modifications.[1]

In regard to cuspids, I wish to be fully understood, and therefore repeat, that from a purely scientific point of view, I do not advocate their extraction; for extraction of a cuspid when it can be moved into its proper place cannot be regarded as in accordance with the highest degree of art. But, regarded as an expedient allowable in certain circumstances which are unfavorable to a more scientific course, it must be admitted that it may sometimes be best for the patient. In other words, in treating this subject, the writer has aimed, while demonstrating the importance of saving the cuspid, when possible, to point out by illustration a sufficient number of unfavorable circumstances which show when extraction is permissible.

[1] These are all shown in Part XV., Vol. 2.

CHAPTER LXVIII.

IRREGULAR CUSPIDS.

WHICH BICUSPID TO EXTRACT IN ORDER TO MAKE ROOM FOR THEM.—REASONS GOVERNING THE CHOICE.

IN cases where the patients are willing to undergo a long operation, even though the conditions be such as are illustrated in Fig. 672, I would extract the first right bicuspid and then force the cuspid back sufficiently to make room for the lateral. The left side in this case seems to

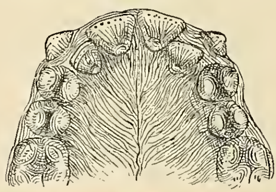


Fig. 672.—Case calling for the Extraction of one of the Bicuspids on each side,—but which ?

require more deliberation, yet it cannot be called difficult. To extract the first bicuspid would leave a space between the cuspid and the second bicuspid, which would be noticeable. The only question is whether this space is more or less objectionable than the operation of moving the first bicuspid back, if the second be extracted.

As these cases are numerous and perplexing, several others, which, when contrasted, show slight differences, will be illustrated and the variations in the operation for their correction pointed out. As we are on the subject of extraction, those cases which require enlargement of the arch, not combined with extraction, will only be referred to briefly.

While slightly irregular teeth will often correct themselves if room is made for them by judicious extraction of some tooth or teeth, those that overlap considerably and are very much jumbled together, require, as a rule, something more than extraction. This, however, depends much upon the age of the patient. If taken before the teeth become firmly fixed in their places, some cases that are very irregular will improve themselves to a surprising degree, and although not becoming perfect in arrangement, may be sufficiently so to satisfy the patient. After twenty-five years of age, few such cases fully amend themselves, but under fifteen the chances for beneficial natural action in this respect are often excellent.

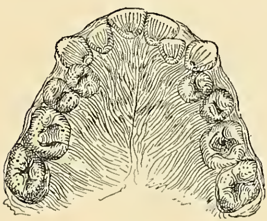


FIG. 673.—Showing the Appearance of a Case before the Operation.

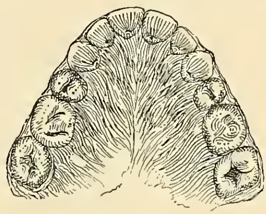


FIG. 674.—Appearance fifteen Months after Extracting the first Bicuspids. No Fixtures used.

To show in what a remarkable degree some cases will change by the aid of extraction solely, that of a boy about eighteen will be given. The upper jaw of the patient, as it appeared before the operation, is illustrated by Fig. 673, and the appearance after the operation by Fig. 674. The cuspids stood in the anterior position ; the laterals and first bicuspids in the posterior, with slight irregularity in some of the remaining teeth, as shown in the figure. Having obtained a cast of the case for future reference (Fig. 673), the first bicuspids were extracted and the case then left to nature for fifteen months, in which time the alteration shown in Fig. 674 took place.

To show more clearly the changes in the position of the teeth in this case, the reader is referred to Fig. 675, in which the dotted lines indicate their position before extraction, and the plain lines the position of the teeth at the expiration of this time.

In measuring casts for drawing illustrations for this work,

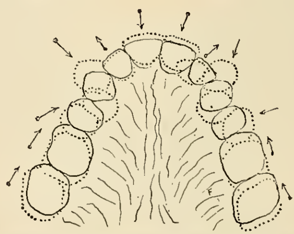


FIG. 675.—Diagram showing the relative Changes brought about in fifteen Months from Extraction alone.

I have found verified several interesting observations of others in the behavior of overcrowded teeth when liberated by having some of them extracted. One of these is the forward movement of the teeth posterior to the spaces left by the extracted teeth, and the posterior movement of the centrals, as well as the falling into line of the laterally standing side teeth. These changes are accurately shown in the figure, the direction of movements being indicated by arrows. Besides such changes, the measurements corroborate the statements of observers that the extraction of crowded lower teeth sometimes leads to narrowing of the middle portion of the lower dental arch ; but this change is slight, and is to be attributed more to improper antagonism than to liberation.

Fig. 676 illustrates a somewhat difficult case requiring the turning of three of the incisors as well as their movement outward, in order to place them properly in line. As this part of the operation is not relevant to the subject of the chapter, and will be fully treated in the chapters on Turning Teeth,[1] it will not now be considered. Leaving the turning part of the operation out of the question, the re-

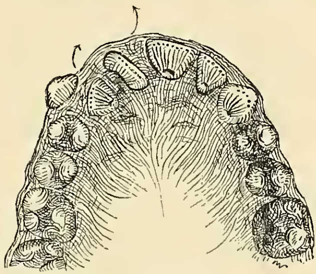


FIG. 676.—Case requiring the Extraction of one Bicuspid only.

mainder becomes easy, and consists first in taking the combined measure of the incisors, and then marking off from the median line a distance that will correspond. This would not leave room enough for the cuspid; therefore the question is narrowed down to which of the right bicuspids should be sacrificed. If the first one should be extracted, there would be left more room than the cuspid could fill, unless one or two teeth posterior to it were moved forward. If this is not thought advisable, then the second bicuspid should be extracted, and the first bicuspid moved back sufficiently to make room for the cuspid. To break the reactive tendency

[1] Vol. 2.

of the tooth to return, the first bicuspid in such cases should be carried fully back against the first molar, and then, after the teeth are corrected, it should be liberated so as to let it return to the cuspid. Figs. 677 and 678 illustrate two cases,

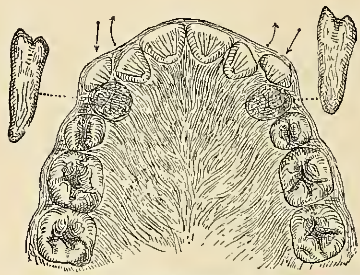


FIG. 677.—Case requiring the Extraction of the first Bicuspids.

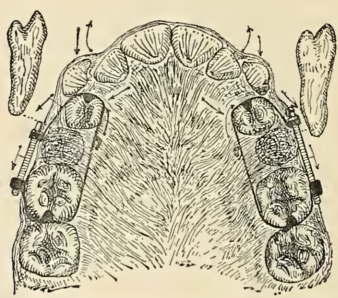


FIG. 678.—Case requiring the Extraction of the second Bicuspids.

which, at a casual glance, appear very similar, but which required different treatment. In the former case, all that was necessary was to extract the first bicuspids, which made sufficient room for the cuspids and laterals. The teeth in such cases, if the patient is not too old, will then sometimes move into line of themselves, as indicated by arrows. The case illustrated by Fig. 678, however, required the extraction of the second bicuspids, after which the first bicuspids, cuspids, and incisors were moved by art in the directions indicated by arrows. The reasons for this method of procedure were to place the superfluous spaces further back in the mouth.

Figs. 679 and 680 are two other cases, quite similar in ap-

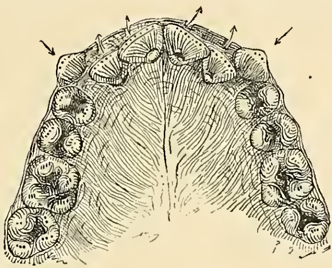


FIG. 679.—A Case requiring no Extraction.

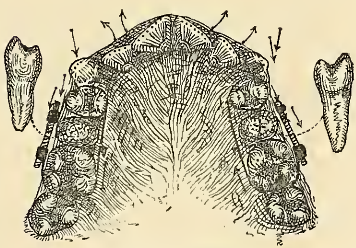


FIG. 680.—A Case requiring Extraction. Beginning of second Stage of Operation.

pearance, but both of which also required very different treatment, calling in the aid of mechanical devices ; but as the manufacture and application of such auxiliaries are the subjects of other chapters, they will be here treated only as subordinate to the question of extraction. The front teeth of the former case (Fig. 679) shut inside of the lower dental arch when the mouth closed, causing the upper lip to fall in. This required the retention of all the teeth, and the forcing of them forward over the lower teeth; a result which was attained by tying them to a long-band. The cuspids were forced into line by the pressure of the same device; the movements of these teeth were as indicated by arrows. The time necessary for the completion of such operations as this varies from two to four weeks.

Quite different from this, however, is the treatment of such cases as illustrated by Fig. 680, in which the spaces between the laterals and first bicuspids are considerably greater. Although in appearance this case was similar to the foregoing, the forcing of the incisors sufficiently forward to admit the cuspids into line would have made the upper lip too prominent and unsightly. Even if this had not been a disfigurement, the placing of the cuspids in line without extracting any of the teeth would have been unwise, because the crowding would then have been so great as finally to push some of the teeth out of line. Under such circumstances, the laterals are generally the teeth that suffer, and the irregularity consists of an overlap.

An important feature to be considered about such cases is that each of these methods of treatment has some drawbacks. To save all the teeth would protrude the lip, as before said, or cause overcrowding; and to extract the cuspids would leave wide spaces between the laterals and first bicuspids; nor would the extraction of the first bicuspid instead of the cuspid leave much less space. Even to extract the second bicuspid, and move the first bicuspids back sufficiently to let the cuspid into line, would leave gaps between them and the first molars, unless the moving of the molars forward is taken into the operation, as is here shown in the placing of the clamp-band so as to include them only. Still, the latter plan is preferable to "letting alone," because it promises the most benefit and the least injury. In other words, this method corrects the irregularities with the least drawback, leaving the spaces so far back in the mouth that they are not conspicuous even in a woman, and not at all in the man who wears a mustache. My usual plan of treatment, subsequent to the extraction of the second bicuspid, is to place a screw clamp-band around the bicuspid and two molars (not one, as shown in Fig. 680), and then draw upon the bicuspid, often bringing the teeth into contact and holding them there for several days until the reactive tendency is greatly broken, and the cuspid has opportunity to take its place in line; and if nature does not cause the cuspid to follow fast enough or not at all, it is compelled to do so, by the addition of an extension-band to the screw clamp-band. This extension-band is shown in Fig. 681.

When there is a doubt as to the firmness of one molar being sufficient anchorage to move the cuspid, after having moved the first bicuspid, this including of the second molar within the clamp-band is important. After these teeth are regulated, as a matter of prudence they should be held in place by a retaining device for several months. If there should be a space remaining between the first bicuspid and molar it may close in the course of a few years by the forward movement of the molar, but this cannot be relied upon. When it is necessary to extract the second bicuspid, and move back the first bicuspid and cuspid, and at the same time to draw the lateral into line, I usually draw back the cuspid by an extension-band and then add the long-band. This long-band is shown in Fig. 681 as tied to the incisors, but for clearness of relation to the parts, is represented as detached from the anchor-bands to which it is made to be fastened by bolts at both ends resting in triple nuts on the rear part of the bands. For further information regarding the construction of these devices, see pages 419 to 425, on the screw clamp-band.

When applying the long-band, it should not draw tightly upon the more prominent teeth unless they require to be moved inward; but it should rest lightly upon these teeth to prevent it from playing up and down. If, however, the eruption of the front teeth is arrested and they need to be drawn down, this tension may be made serviceable, but in such cases the long-band should have two lug-nuts as shown on page 327.

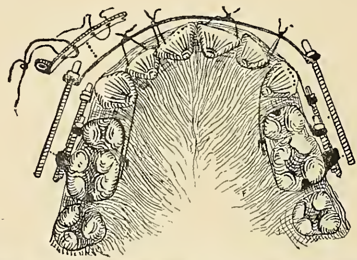


Fig. 681.—Beginning of the third and last Stage in the Process of correcting the Case shown in Fig. 680.

Sometimes when the front teeth stand considerably to one side of the median line, it is not necessary to extract more than one side tooth. A slight difference between the position of the centrals and the median line of the nose and lips is more frequently found than absolute exactness in this respect.

CHAPTER LXIX.

EXTRACTION FOR THE CORRECTION OF IRREGULAR LOWER INCISORS, CUSPIDS, AND BICUSPIDS.

AID OF MECHANICAL DEVICES SOMETIMES NECESSARY.

HAVING considered the question of correcting irregular upper anterior teeth by extraction, we now come to the correction of the lower teeth by the same means. Brief reference has unavoidably been made already concerning the disposition of the lower cuspid, but the object now is to consider all the teeth.

In cases where the order of the eruption of the adult teeth is normal and where a lateral slightly overlaps the central, the child-cuspid and molars being yet in place, after waiting until the gum shows strong evidence of the forthcoming of the adult-cuspid and perhaps the first bicuspid, it is well to extract the child-cuspid and first molar. This not only makes room for the unerupted adult-cuspid and the bicuspid, but also liberates the overcrowded adult-incisors. I find that, generally, this method is sufficient for the purpose without the use of mechanical devices, for this reason; as the lower adult-cuspid, contrary to the rule in the upper jaw, usually erupts before the first bicuspid, both the adult-incisor and cuspid will then have ample room to form in line. If there should, however, be insufficient room for the first bicuspid to erupt, more room may be added by extracting the second child-molar, which, being considerably larger than its successor (the second bicuspid), will generally leave ample room for both bicuspids. If, however, it does not, then something further becomes necessary,—extraction of a bicuspid or the first adult molar. This point will be considered after that of the incisors.

The management of slightly irregular adult lower incisors, after the eruption of the adult cuspids and bicuspids, gives rise to differences of opinion, but when very much overcrowded their regulation does not present much difficulty to an experienced operator, because, as stated in a previous chapter, the lower incisors are so nearly of the same size and shape that the loss of one is but little, if at all, noticed. Therefore, when the arch is large enough and yet is overcrowded, no space existing along the line into which adjacent teeth can be moved to make room for the incisors, and it seems not advisable to extract any of the side teeth, I think that the extraction of one judiciously selected incisor is not only allowable but also the best course to pursue. The degree of success in these cases, as in many others, often depends upon their original relations; for, while some teeth may stand so nearly parallel with adjacent teeth after the completion of the operation that their arrangement appears nearly perfect, others incline so much, that the irregularity can only be partially remedied. The selection of the tooth for extraction, therefore, should not be made without careful deliberation, for we should be governed as much by the position of the roots as by that of the crown. If the root is too far out of place, the crowns of the remaining teeth when moved into line may incline too much, so that the result might be nearly as unsightly as the original irregularity. This caution should not, however, discourage the effort to regulate.

There is another question which should be considered as to the extraction of lower incisors—namely, the advisability of widening the arch to liberate the overcrowded teeth. The possible falling in of the anterior portion of the sides of the arch from loss of support, although not a frequent occurrence, must also be taken into calculation.

From what has been said, the reader will see that, before extracting a lower incisor, every tooth should be carefully examined to determine the relative position of the apices of the different roots, with a view to selecting for removal the tooth that will permit the remainder to make the best appearance when moved into line.

Although after the extraction of a tooth the incisors will generally move more or less toward their proper places, this natural force cannot always be depended upon, and mechanical aids may be required to insure success. When it is desirable to correct lower incisors without extracting any of them, it may sometimes be accomplished by extracting a side tooth, for instance, a bicuspid, and then moving the cuspid into its place. This occasionally requires somewhat expensive apparatus. But when one of the incisors is extracted, expensive apparatus is rarely needed, as that operation frequently simplifies the process to such an extent as to require no further aid than skillful application of an elastic ring cut from rubber tubing: especially is this true of child-patients, and sometimes for those of adult or nearly adult growth. A spring fixed to a hard rubber plate, or a simple metallic clamp-band tightened by a screw is all that is generally necessary for average cases. The method of placing these simpler devices on teeth varies with circumstances. All that is requisite when a rubber elastic ring is used is to stretch and lodge it around and between the teeth so that it will tend to move them in the desired direction. Metallic springs should be so anchored to some tooth-band or a plate that pressure will be exerted against the tooth as desired. Both of these devices act upon the principle that causes continued pressure, which for adult cases may be painful, unless the force is weak. In cases of young children, however, this character of force is better tolerated by the tissues, and as the operations are usually of short duration, they are generally willing to submit to the annoyance.

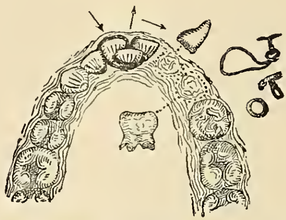


FIG. 682.—Application of Elastic Rubber and Gold T (A).

Case I.—Fig. 682 illustrates a case which was treated by the use of an elastic rubber ring fixed to a gold T piece[1] caught over the adult incisors after the extraction of the right deciduous cuspid and first molar, leaving the second (deciduous) molar as shown in the figure. This extraction

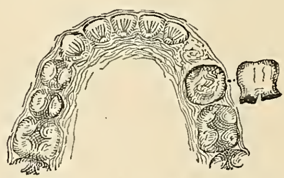


FIG. 683.—Appearance after the Operation.

made ample room, and the incisors readily moved into line, as shown in Fig. 683. As will be seen, there was not then sufficient space left for the eruption of the two next teeth; cuspid and the first bicuspid. To meet this want, the second deciduous molar was now extracted.

[1] 1876.

This made sufficient room for these two teeth, yet it was evident that there would not be enough space for the second bicuspid; but as the first adult molar was sound, the case was suspended until the first bicuspid should have time to erupt. When it came into view sufficiently to apply the forceps, this first bicuspid was extracted; thus making space for the cuspid and second bicuspid, leaving no noticeable gap. The incisors were corrected, without difficulty, in one week by the elastic rubber ring and the T, and subsequently the adult cuspid and the second bicuspid took their respective places.

In such a case the propriety of extracting a bicuspid instead of a sound first molar is very apparent. If the

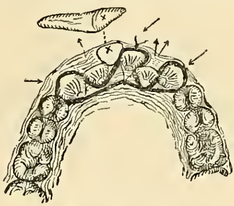


FIG. 684.—Before the Operation.

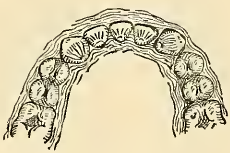


FIG. 685.—After the Operation.

molar had been badly decayed, the treatment would have been extraction of that tooth, which would have afforded ample room for both bicuspids, and yet left but little space. The question in the above operation was whether anything was gained by saving all the incisors at the expense of a bicuspid, or whether it would have been better to extract the right central.

Case II.—Fig. 684 illustrates an older case as it appeared before an operation. This belongs to a class of irregularities that are easily corrected. The left central was extracted, after which a rubber ring was caught over the cuspid on the left side, and stretched across the arch, thence between the cuspid and first bicuspid. The anterior side of the ring was then woven among the incisors, as illustrated by the black line; this, the first step, left the rubber acting, in the direction indicated by arrows, upon the different teeth. To reduce the inconvenience arising from the extension of the posterior half of the rubber across the mouth, it was drawn forward by a thread and tied to the right central, as shown.

Fig. 685 illustrates the appearance of the same case at the end of two weeks. No attempt was made to correct the right cuspid, which stood askew.

This method, which has long been practised, is so simple

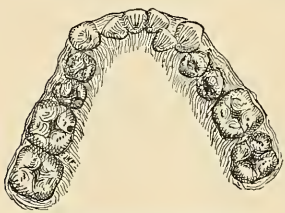


Fig. 686.—Lower Jaw before Treatment by Extraction.

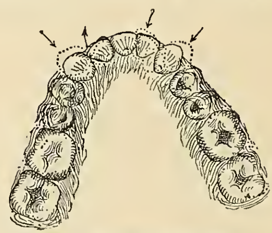


Fig. 687.—Same after Treatment by Extraction.

that patients or their parents, by a little instruction, can generally do most of the work themselves. To retain the teeth in position after correction at this age, the patient, in many instances, need only continue to wear for a few weeks the same elastic or a weaker one, or even a thread. As the successful use of rubber rings for correcting the front teeth of children under ten or twelve years of age is so simple, it does not seem necessary to further dwell upon it.

Fig. 686 illustrates the case of a boy about seventeen, whose teeth were corrected, by extraction, to a degree that satisfied him. The cuspids stood in the anterior position, and the laterals (outer corners of which were turned in) stood in the posterior, the right one much further than the left, leaving between the right cuspid and central a bay-like space which was nearly half of the diameter of the lateral in width. The right lateral was extracted, after which the operation was suspended for about a year. The changes that took place during this period are shown by dotted and plain lines in Fig. 687, and the direction of movement of the teeth is indicated by arrows.

The degree of self-correction in this case must be regarded as exceptional, for although nature, alone, frequently improves cases after extraction, the complete correction of deformity usually requires the aid of regulating devices.

For illustrations and explanations of the various methods of correcting the teeth of adults by the use of different mechanical devices, the reader is referred to Part XV., Vol. 2.

Conclusion.—To reiterate concerning adult-cuspids, after examining the condition of antagonism, it is necessary in the first place to decide the question whether any room is really needed for the cuspids. If there is, then the point to determine is, whether to wait for the possible enlargement of the alveolar arch by natural growth, or to force an enlargement by art, or to extract some teeth. The first is taking an uncertain course, which in many cases would permit subsequent irregularities, and would lead to correction only in exceptional instances; the second, enlargement of the ridge by art, if proper, is not always practicable because of the circumstances of the patient; the third, extraction of a tooth from an arch already too small, is manifestly (esthetically speaking) an error. But, assuming that the removal of an adult tooth is allowable and necessary, the next important point to decide is, which one? If the first adult molar is sound, the question then becomes narrowed down to a choice between the first or second bicuspid, or one of the incisors. This depends upon the relative position of the crowded teeth. If a lower lateral incisor is much turned in the socket, or is otherwise considerably out of position, so that regulation would be too troublesome and expensive a process, and if, by the extraction of one of the incisors, the cuspid and bicuspids would have sufficient room to form in line, it might then be proper to follow this course. But if it would not, then if the extraction of the first bicuspid would leave no space after the full eruption and correction of the remaining teeth, this would seem to be the proper course to pursue. But, if it would, leave a space, then, instead of this plan, the extraction of the second bicuspid and the forcing back of the first bicuspid sufficiently to let the anterior teeth fall into line would be the most judicious course, because the space would be farther back and less visible, possibly not at all.

CHAPTER LXX.

EXTRACTION FOR CORRECTION OF NON-OCCLUSION OF THE ANTERIOR TEETH.

CAUSES OF THE DEFECT.—CASES APPARENTLY SIMILAR REQUIRING DIFFERENT TREATMENT.

AS mentioned in the closing chapter of Part XII., (which is devoted to the treatment of similar cases by grinding), the non-occlusion of the anterior teeth consequent upon the too early contact of some tooth or teeth, especially of the posterior teeth, is a form of irregularity which sometimes arises from an abnormality of the jawbones; but it frequently happens that these teeth are arranged in regular order in the arch, and when the jaws are inspected individually they appear perfect, the fault lying only in their relation to each other. The distance at which these teeth are held apart varies from one-eighth to one-half of an inch, and in rare cases even more, causing elongation of the face and imparting a drawn expression. Nor is this all, for speech and mastication are often rendered imperfect.

It sometimes happens that supernumerary teeth also present themselves singly or in groups in places where they can do no harm (and where they may even act as substitutes for some missing members); but, generally speaking, their presence is objectionable because of their interference with the antagonism, holding the jaws apart or crowding the normal teeth out of place. In such cases, extraction is the usual and proper treatment.

Case I.—Fig. 688 illustrates the case of a girl about seven years of age, whose central incisors, which had erupted regularly, were subsequently separated by a supernumerary located as shown. This case was treated

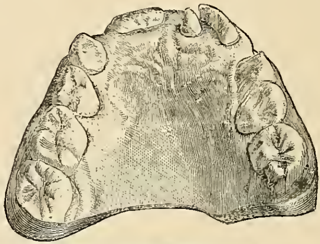


Fig. 688.—A Supernumerary Tooth.

by extracting the intruding tooth; after which the regulation of the centrals was left to nature. In a few weeks the gap closed by the return of the central incisors to place, and in about one year they even overlapped to such an extent that they were a disfigurement. As these teeth were decayed in the mesial sides, I was able, by

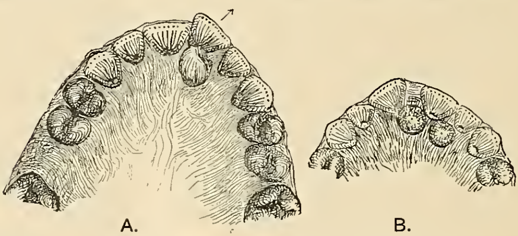


Fig. 689.—Supernumerary Teeth.

grinding, to do away with the lap in the preparation of the cavities.

Fig. 689 A shows a similar case in a girl of about fifteen years of age, the position of the new tooth being analogous, but the effect upon the other teeth was quite different. The remedy in this case was the same as in the other, extraction, after which the central fell back into position.

B is a bottom view showing the conditions in the case of a boy twelve years old, who had two supernumerary teeth located, as shown. As the difficulties in these three instances were of a similar character, the treatment of all was by extraction. Sometimes several supernumerary teeth appear one after another, thus causing considerable alarm to the patient, but if they are disposed of by extrac-

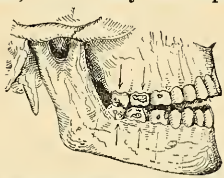


Fig. 690.—Non-occlusion of front teeth from too early antagonism of the Molars.

tion as soon as they are sufficiently developed no harm will arise from them.

In cases where non-occlusion of the anterior teeth is occasioned by too early contact of the posterior teeth they are treated differently according to circumstances. The front teeth may be made to antagonize by extraction of some of the posterior teeth as well as by grinding their cusps away.

Case I.—Miss C. S.——. To give an instance of the former method, a case which I treated in 1865 will first be cited, that of a woman of twenty years of age. There was a space between the anterior teeth of more than a fourth of an inch, elongating the face correspondingly, and necessitating a considerable effort in closing the lips, as well as rendering her speech indistinct. The deformity had existed from the time of the eruption of second and third molars, and was supposed by her to be irremediable, until severe toothache compelled her to apply for relief. From appearance her defective speech was caused entirely by the non-occlusion of the anterior portion of the dental arches. Upon examination it was found that only the second and third molars antagonized and that these were considerably decayed. With a view to making a radical improvement with one bold stroke, all the teeth posterior to the first molars were extracted, when the toothache disappeared at once and the anterior teeth came together; her face shortened, and the drawn or forced appearance of the lips gave way to an easy expression. Within a few weeks the lisp also disappeared. In this case, the alveolar ridges in the region about the teeth that were extracted were so nearly in contact that to attempt bringing the front teeth

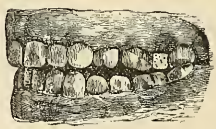


Fig. 691.—Appearance before the Operation (Keely).

together by grinding would have occasioned severe pain, unless their pulps were first destroyed, which was not thought advisable. By the method adopted, this great deformity of face and imperfection of speech caused by too short a ramus (see Fig. 690), was quickly corrected.

Case II.—The following is the substance of a report of a case of a young man, twenty years of age, treated by Dr. Geo. W. Keely.[1]

Fig. 691 shows the lack of antagonism of the teeth. The second upper bicuspid on the left side was lost, and the first lower molars had been extracted at the age of about ten years. This permitted the second molar to move forward

[1] From the "Ohio State Journal of Dental Science," 1883.

and occupy the space on the left, which in turn hastened the eruption of the third molars. When the patient presented himself for treatment, the third lower and second upper molars were the only teeth that antagonized. The figure illustrates the case after the left first upper molar had been wedged forward when the patient was having some teeth filled, and before Dr. Keely had decided what method to adopt in order to make the anterior teeth antagonize. The second right lower molar was also drawn forward, leaving a space of one-eighth of an inch between it and the second bicuspid. There was also a space between the anterior teeth of the two jaws caused by contact of the

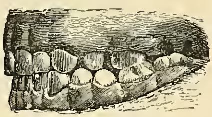


FIG. 692.—Appearance at Time of Extraction.

posterior molars as above mentioned. Not only was the speech defective, but the patient also complained of his jaws feeling "tired all the time," and occlusion of the front teeth being impossible, he was obliged to masticate food by the posterior molars only.

The second upper molars were sound, as were also the third lower molars. It was decided that the only possible means of benefit was extraction of the second upper molars. After this operation the patient said that his jaws had never before felt so comfortable. Some of the sharp cusps of the anterior molars were then so reshaped that the jaws, when brought together, drove the teeth forward. Fig. 692 illustrates the appearance of the case at this stage. The second lower and first upper molars and all the anterior teeth, excepting the bicuspids, were then in contact.

Dr. Keely says that the diagnosis of this case was as follows: "1st. That the removal of the second upper molars was the only possible means by which all the anterior teeth could be brought in contact. 2nd. That it was evident that the third upper molar would shortly erupt, and take the place made vacant by the second,—and that it would develop better by having ample space, and come squarely in contact with the third lower molar. 3rd. That within a few years the bicuspids would elongate and come in contact."

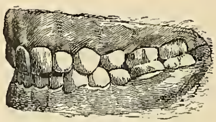


FIG. 693.—Appearance ten years after the Operation.

How accurate this diagnosis proved to be may be seen by reference to Fig. 693, which illustrates the appearance of the case ten years later.

Case III.—Fig. 694 illustrates an extreme case of this deformity, caused by abnormality of the bones, which came to my knowledge in consultation with a member of the profession, and is so interesting that I introduce it to serve as a lesson. The patient was a boy about ten years of age. He had lost all the deciduous teeth of the lower jaw (the successors of which had erupted), but the corresponding (child) molars of the upper jaw yet remained; the first adult molars had appeared and the (adult) incisors were about three-fourths erupted. As the figure shows, the spaces for the yet unerupted adult cuspids were not of sufficient width to accommodate them, and consequently they would be forced to erupt out of place unless room were made by extraction of some teeth. Examination showed that the abnormality was principally confined to the upper jaw; while the jawbone along the bicuspid and molar region was normal or perhaps somewhat in excess, that of the region of the incisors and cuspid was deficient, thus preventing the occlusion of the central incisors nearer than three-eighths of an inch. This caused the anterior portion of the jaw to appear curved upward. The question was whether any-

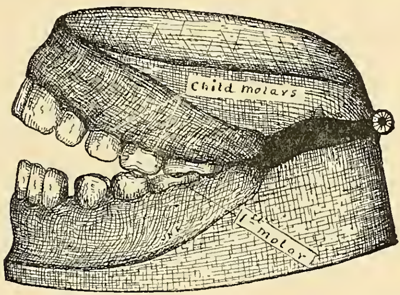


FIG. 694.--Non-occlusion of the anterior Teeth from malformation of the Upper Jaw.

thing could be done toward remedying the defect. Although the lower jaw was nearly normal, the upper was so greatly deformed that improvement was regarded as being only partially possible. To cause the anterior teeth to occlude by drawing them partially from the socket would be impossible, as the distance to be spanned was too great. To depress the posterior teeth which were already nearly buried in their sockets, especially those of the lower set, would be worse than useless, as it would be liable to cause pressure on the (lower) dental nerves, and induce neuralgia. My advice was, in the first place, to bring about radical absorption of the posterior portion of the alveolar ridge of the upper jaw by extracting the two upper child-molars and the first (upper) adult-molar. This would make ample room for the (upper) bicuspids and liberate the unerupted (upper) cuspid. Even if the first bicuspid should erupt too far forward it could be forced backward to make room for the cuspid. This extraction would also at once permit the lower jaw to move up so that the anterior teeth would occlude or nearly so, when the relations of the two jaws would point out the future course to pursue in regard to the

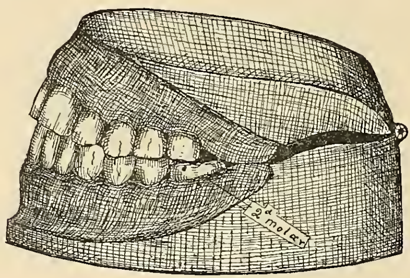


Fig. 695.—Showing how Case in Fig. 692 might have been corrected.

lower teeth. I was under the impression at the time that the extraction of the first (lower) molar,—(to say nothiug of the advantage to be derived from making room for the imprisoned lower cuspid by moving the bicuspids back),—would cause so great a degree of absorption of these portions of the alveolar ridge that when the second adult molars should develop they would stand in a position that would possibly render it unnecessary to extract them. Even if their extraction, and also that of the third molars, should prove necessary, the antagonism of the incisors, cuspids and bicuspids, with the close contact of the gums posterior to the latter, would be as useful for masticating purposes as the teeth under their present conditions; and probably better. Besides this, the personal appearance of the boy would be very much improved. The only question as to the results of such a procedure is whether it would be possible to save all the bicuspids, by moving them back, and whether it would not be better practice to extract one on each side in favor of a molar, to be subsequently ground shorter.

Fig. 695 illustrates the condition that I should have aimed to bring about had the case been mine, and which I think might have been effected. The figure represents the first lower molars as extracted, the bicuspids moved back, and the cuspid as having erupted into line, and the subsequent eruption of the upper cuspids and second lower molars, with the cusps of the bicuspids ground away.

As, however, this patient lived in a remote State I lost sight of the case, and have not learned what was its actual termination.

END OF VOL. I.

INDEX.

B.

C.

D.

G.

J.

M.

N.

R.

S.

U.

V.

W.