Orthodontia, or, malposition of the human teeth : its prevention and remedy / by S. H. Guilford.

ORTHODONTIA,

OR

MALPOSITION OF THE HUMAN TEETH;

ITS PREVENTION AND REMEDY.

BY

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Approved by the National Association of Dental Faculties as a text-book for use in the schools of its representation.

THIRD EDITION, REVISED AND ENLARGED.

PHILADELPHIA:
PRESS OF T. C. DAVIS & SONS,
529 COMMERCE STREET.

To all
those, whether Teachers,
Practitioners or Students, who are
deeply interested in the Art and Science of
Orthodontia, this Third Edition is respectfully inscribed.

Preface to First Edition.

This work has been written at the request of the National Association of Dental Faculties in furtherance of its plan to secure the preparation of a series of text-books for use in American Dental Colleges. After its completion and examination, it was accepted and endorsed by the Association at its meeting in Saratoga, August, 1889.

The impartment of instruction in the simplest and most direct manner being the true province of a text-book, the author has endeavored in the preparation of this work to treat the subject as concisely as possible, and to clothe his thoughts and those of others in such language as to be readily comprehended by beginners as well as those somewhat advanced in this branch of study.

In the treatment of the subject, the aim has been to lead the student step by step from the simplest beginnings to the more complicated and difficult work of practical treatment. To this end, the underlying principles of the art are first elucidated, after which the principal methods employed are explained, and lastly, the correlation of principles and methods is shown in their practical application to typical cases. In Part III., the different forms of irregularity, together with a variety of plans for their correction, are arranged under such headings and in such order as to be readily referred to in seeking aid for cases that occur in office practice.

Should the work fulfill the object aimed at in its preparation, the author will feel amply repaid.

Credit for assistance is most cheerfully given to the twenty-five teachers of this branch in American Dental Colleges who have read this work in manuscript, and by friendly criticism and valuable suggestions added much to its completeness.

The author would also acknowledge his indebtedness to Prof. W. F. Litch for valuable services, and to the S. S. White Co.; Lea, Brothers & Co.; P. Blakiston, Son & Co.; and other publishers and authors for the use of certain cuts.

S. H. G.

Philadelphia, Sept., 1889.

Preface to Third Edition.

Owing to the rapid strides in both the science and art of this branch of dental practice the author, in preparing the present third edition of his work, has taken advantage of the opportunity thus afforded to introduce many changes and improvements.

The work has largely been rewritten, its size increased by more than twenty-five pages, and some fifty new illustrations introduced. Much of the material contained in former editions, which had ceased to be of value, has been excluded and its place supplied by newer matter and methods. Every chapter has been more or less changed to conform to present knowledge and three new chapters introduced. One of these, "Dynamics of Tooth Movement," (Part I., Chapter VIII.,) together with the introduction of many new and etymologically correct terms will, it is believed, add to the scientific value of the work. The addition of a word index should prove of service to the busy practitioner.

The favorable reception given to former editions, as shown by its being placed upon the list of required text-books of many dental colleges, encourages the author to believe that the usefulness of the present edition will be augmented.

The second edition was translated into French and the present one is now about to be published in Spanish.

The author would express his indebtedness to the following fellow-teachers of this branch for valuable aid and sug-

gestions: Professors C. L. Goddard of San Francisco, C. S. Case of Chicago, E. H. Angle of St. Louis and V. E. Jackson of New York.

He would also acknowledge the kindness of the S. S. White Dental Mfg. Co., the Consolidated Dental Mfg. Co., Lea, Brothers & Co., H. D. Justi & Son., B. H. Catching and other publishers, in furnishing electrotypes of many illustrations.

S. H. G.

Philadelphia, July, 1898.

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PART I. PRINCIPLES INVOLVED.

CHAPTER I.

Orthodontia, from *ὀρθός, right, correct,* and *ὀδούς,* a *tooth,* is that branch of dental practice which relates to the correction or prevention of irregularity of position of the human teeth.

Its recognition as a distinct branch or specialty of general dental practice has come about in recent years. Fifty years ago so little was known concerning it that the writers of that day paid little attention to it. Whether the condition of irregularity was less frequently met with then than now we cannot certainly tell, but inasmuch as dentistry was at that time in a somewhat primitive state, and as the most pressing demands upon the dentist of that day were for the alleviation of pain, the substitution of artificial dentures to replace lost members, and the checking of the ravages of decay by filling, it is but natural to suppose that there was little time or inclination to attempt the relief of such an apparently unimportant condition as mere irregularity of position. Since then, however, with the natural growth of dental science and the enlargement of its sphere, the subject of orthodontia has grown in importance until to-day it is engaging the attention of some of the best minds in the profession and forms an important part of the study of every dental student.

With the growth of its interest and importance there has been a corresponding advance in investigation as to the cause and frequency of irregularities, a more exact microscopical examination of the tissues involved and of the

physiological changes occurring in them in the process of correcting such conditions. Progress has also been marked by a more careful study of laws governing the application of force to the moving of teeth and by the invention of a multiplicity of devices and appliances for the more perfect and easy correction of this class of deformities.

REGULARITY AND IRREGULARITY DEFINED.

The teeth of man when normally placed in the alveolar arch describe in outline a parabola or semi-ellipse with a slight flattening of the curve in the region of the incisor and bicuspid teeth, and a consequent tendency to angularity where the cuspids are placed. The lower arch differs from the upper principally in being slightly smaller. The teeth when thus placed should be in contact, each one touching its neighbor at the most prominent points of its approximal surfaces, and with the cusps or occluding surfaces in such position as to properly occlude with those in the opposite jaw. Thus arranged the teeth are called regular, but whilst regular as to alignment they may still be inharmonious in relation to other facial features by either too great prominence or such a lack of it as to constitute a decided deformity. Irregularity as most commonly met with consists in a deviation from the normal outline on the part of several or all of the teeth, or in the malposition of one or more individual teeth; if the latter, the tooth or teeth may be found outside or inside of the regular line of the arch or they may be placed anteriorly or posteriorly to their normal positions, or finally, they may be turned or twisted on their axes. In many cases this torsion is associated with malposition.

Irregularity being an abnormity, corrective measures, as a rule, should be resorted to, but slight irregularities do not always demand interference.

The slight overlapping of the superior centrals by the laterals, for instance, is a clear case of irregularity, but it is so

slight and so commonly met with, that it has almost ceased to attract attention or to be regarded as an abnormity. Artificial teeth are now made reproducing this condition and in many cases are preferred on account of their "more natural appearance."

So too, the slight irregularity commonly found in connection with the inferior incisors, where several or all of them are slightly turned and overlapping, is no longer looked upon as inharmonious and is also imitated in the arrangement of artificial teeth.

Again, the slight misplacement of a tooth in the posterior part of the arch, where it is not noticeable, may be left without disturbance and no harm result.

In cases like these, if the slightly altered position of the individual teeth is not likely to result in injury to tooth structure, or does not interfere with speech or occlusion, it is best to omit any effort toward correction.

CHAPTER II.

ETIOLOGY.

The causes responsible for the production of irregularity are many and at best but imperfectly understood. Some of them are operative before the birth of the individual and others afterward. They may therefore be classed under the two general heads of Hereditary and Acquired.

HEREDITARY.

This class comprises all such cases as are evidently due to the inheritance of peculiarities that existed in their near or remote ancestors, or to some of the characteristics of both parents who were themselves free from dental abnormity.

The well known biological law of transmission of characteristics from parent to child will readily explain how the abnormalities as well as the normalities may be transmitted. The child may bear a close resemblance to either parent in form and feature, or it may combine some of the peculiarities of both. In other cases it will resemble neither, but be like one of the grandparents or other remote relatives.

The evidences of inheritance are perhaps nowhere more clearly expressed than in the dental organs. Not only in these organs as a whole may we see the dental apparatus of a progenitor reproduced in entirety, but the resemblance is equally well shown in the inheritance of so slight an abnormity as a turned or misplaced tooth. Sometimes such peculiarity may be inherited by several children in the same family.

Cases of irregularity due to inheritance are oftentimes the most difficult to correct, for not only must mechanical difficulties be overcome, but in addition the influence of physical impress, confirmed perhaps by repeated transmission,

must be combatted. The mechanical difficulties in such cases are as readily conquered as in others, but the force of inheritance will show itself in a strong and stubborn tendency on the part of the teeth to return to their former abnormal positions.

The intermarriage of races with widely differing characteristics has come to be regarded as one of the most prolific causes of dental irregularity. If both races represented in the marriage possess somewhat similar characteristics as to size, vigor and feature, no dental peculiarity will usually be found in the offspring; but where the differences are marked, irregularity of the teeth will often be the result.

When one parent possesses a large frame with full-sized teeth set in large jaws and the other a small frame with correspondingly small jaws and small teeth, the child may inherit the large teeth of one parent and the small jaws of the other. The small jaws cannot accommodate the full complement of the larger teeth, and hence a crowded and irregular dental arch will be the result.*

Where the small teeth of one parent and the large jaws of the other are found united in the offspring, abnormal interdental spaces will frequently be the result. These spaces may exist between all of the teeth, or, as in some cases, the deformity will only be found in connection with the anterior ones. Cases of this character, fortunately, are infrequently met with, but when they occur they present an unsightly appearance, and generally result in an earlier loss of the teeth from that lack of contact and mutual support so necessary to their longest retention and usefulness.

*Dr. J. M. Whitney, of Honolulu, in a paper read before the World's Columbian Dental Congress in 1893, entitled, "Among the Ancient Hawaiians" says:—We have often accounted for the irregularity of teeth found so commonly among Americans, by the mixture of races of which our nation is composed. . . . . But here is a people, isolated from all others for at least fourteen hundred years, with no admixture of races; yet irregularity of the teeth of both maxillaries was almost as common as it is among the mixed races of to-day.

ACQUIRED.

The causes productive of irregularity during dentition or subsequent to it far exceed in number those due to heredity.

Long Retention of Deciduous Teeth.—In accordance with physiological law, the deciduous teeth are intended to subserve the wants of the child until replaced by the permanent set. The crown of the permanent tooth should occupy a position beneath or adjacent to the root of the deciduous one which it is intended to supplant. Then, as the root of the temporary tooth is gradually resorbed, the permanent tooth advances and finally occupies the position previously occupied by its predecessor.

It frequently happens, however, that the crypt of the permanent tooth is situated at some little distance from the root of its corresponding deciduous one, and as the new tooth makes its way into place it assumes a position to the side of the deciduous root. As usually that part of the root is resorbed which is in contact with the vascular covering of the advancing crown, a portion of the length of the root remains unabsorbed, and the new crown is, in consequence, compelled to advance by the side of the root instead of beneath it. The deciduous tooth as a result of its only partially resorbed root, remains firm in place, and the new one is erupted out of its proper position. Had the condition been brought to the attention of the dentist before the new crown appeared, the extraction of the deciduous tooth would have permitted the advancing tooth to assume its proper position in the arch and irregularity have been prevented. When the permanent tooth is advancing out of position the fact may be recognized by the unusual distension of the gum and alveolar plate beneath, and the deciduous tooth, no matter how firmly set, should at once be removed. Even the spicula of a deciduous root has been found sufficient to deflect a permanent tooth from its course during eruption.

Early Extraction of Deciduous Teeth.—That the premature extraction of deciduous teeth often prepares the way for

irregularity of the permanent set is generally recognized, but the extent of its importance and the manner in which it operates can best be understood by considering the physiological facts in the case.

Irregularity of the deciduous teeth is a condition very seldom met with. As a rule they occupy their normal position in an alveolar arch of proper size to accommodate them, and this again rests upon a jaw bone of suitable amplitude. Thus jaw, process and teeth are harmoniously correlated. As each deciduous tooth is lost it is succeeded by the corresponding permanent one, which, under normal conditions, will occupy the space created by the removal of its predecessor. In this way, one by one, the permanent set should make its appearance until all of the deciduous teeth have been supplanted by their permanent successors.

The permanent teeth are all larger than the corresponding ones of the deciduous set, with one exception,—the second bicuspid. This being the case, they require a larger alveolar arch and a correspondingly larger jaw bone for their accommodation. This nature furnishes by the slow process of enlargement by interstitial growth, which is hastened and stimulated by the lateral pressure of the teeth as they make their way into place, and afterward. When the first permanent molar makes its appearance it is obliged to provide sufficient accommodation for itself by forcing its way between the deciduous second molar and the strong maxillary tuberosity above or the equally resistant ramus below. This pressure is felt by all of the other teeth in the arch. If, therefore, any of the deciduous molars should be extracted about the fifth or sixth year, for instance, as they too often are after having been impaired by disease, the permanent molar will move forward and occupy part of the space intended for the bicuspids.

When the permanent lower central incisors erupt they make their appearance inside of the line of the deciduous ones, which soon loosen and drop out. Owing to the fact

that the width of these new teeth is considerably greater than that of their predecessors, they naturally overlap to a certain extent the adjoining deciduous laterals. This overlapping prevents the centrals from moving forward into line in the arch. When the permanent laterals erupt they assume a position by the side of the centrals, and to find accommodation in this contracted space inside of the arch several or all of them are apt to be crowded into irregular positions.

This condition, from the fact that these teeth have erupted too rapidly to admit of a corresponding increase in size of the alveolar arch, is often regarded as a serious evil, and to correct it, the inexperienced practitioner will in many cases extract the temporary cuspids which are designed for retention until years afterward. This additional space having been thus furnished, the permanent incisors will move forward into line and assume a regular position.

Later, when the bicuspids appear, they will usually find no difficulty in assuming places in the arch, because their predecessors occupied a larger space and because the cuspids are missing, but from the very abundance of the space and the pressure of the first molar from behind, the bicuspids will very soon, if not at once, be so pressed forward that the first bicuspid will come in contact with the lateral, leaving no space for the accommodation of the cuspid when it makes its appearance at about the eleventh or twelfth year.

Such being the case, the cuspid must of necessity erupt outside or inside of the line of the arch, and produce a deformity both unsightly and hard to correct.

Had the temporary cuspids not been extracted, they would have preserved space for their successors, and the inlocked and irregular incisors, in the course of time, by the normal enlargement of the arch, and the excess provided by the removal of the deciduous molars, would have had space sufficient, which nature, assisted by the pressure of the tongue, would aid them in occupying.

The same condition is met with in the superior arch, perhaps more frequently than in the inferior. Here the incisors erupt outside of the line of the deciduous ones, and sometimes appear in an irregular and crowded position, to correct which the temporary cuspids are often needlessly sacrificed, and the same train of evils follows.

It will thus be seen that the premature extraction of any of the temporary teeth, especially the cuspids, cannot well result in other than harm to the permanent ones, so far as regularity is concerned.

Sir John Tomes relates a case in which he extracted for cause all of the deciduous teeth of a child, and yet when the permanent ones appeared they assumed their proper positions in the arch without any resultant irregularity.

This one case, however, the only one of the kind on record, does not disprove the facts as noticed in thousands of cases of opposite character, nor does it confute the plainly apparent workings of physiological law. It simply illustrates what nature may do in a single case under conditions exceptionally favorable.

Injudicious Extraction of Permanent Teeth.—A condition frequently met with after all the permanent teeth have been erupted, is one where in the upper jaw the centrals, bicuspids and molars are all harmoniously arranged, while the laterals occupy a position inside of the line of the arch and the cuspids lie outside of it. The condition is most frequently brought about by the premature extraction of one or more teeth of the temporary set, as described under the last heading.

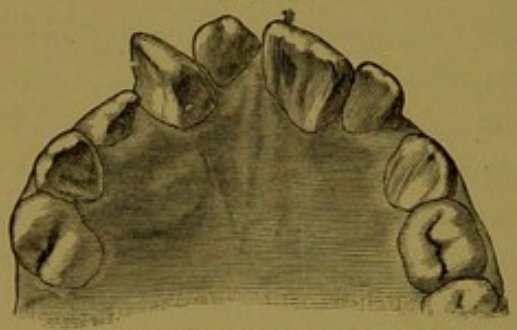
To remedy the difficulty in the easiest manner, some practitioners have at times extracted the laterals and on other occasions the cuspids. The result has been in each case an almost hopeless deformity. The cuspids brought next to the centrals oftentimes gives to the face a canine appearance, while with cuspids lacking the countenance is robbed of that prominence near the angles of the mouth so necessary to harmonious expression.

Again, the permanent first molars of one of the jaws are often neglected until caries has made serious inroads upon them, when they are extracted as offending members. The result is that the lateral pressure, so necessary to proper expansion of the process is lacking in one jaw, while in the other the normal enlargement continues. As a consequence there is disparity as to size between the two jaws, and the appearance of the individual is perhaps permanently marred.

Delayed Eruption of Permanent Teeth.—It sometimes happens, from causes not easily definable, that the eruption of one or more of the permanent teeth is retarded to such a degree that the rest of the set take positions in the arch and occupy all of the space. When the tardy member is ready to erupt there is no place for it, and it is compelled to take a position outside or inside of the line. This is apt to occur more frequently with the cuspids than any of the other teeth, although it is occasionally met with in the case of laterals and bicuspids.

Supernumerary Teeth.—Supernumerary teeth are very frequently found occupying a position in the arch before the eruption of the permanent set, so that when the latter appear there is insufficient room for some of their number, and these are forced to assume an abnormal position. Such supernumerary teeth as appear in the line of the arch and in the anterior part of the mouth are usually small and of the conical or *peg-tooth* variety, and are most frequently found between the central incisors.

FIG. 1.



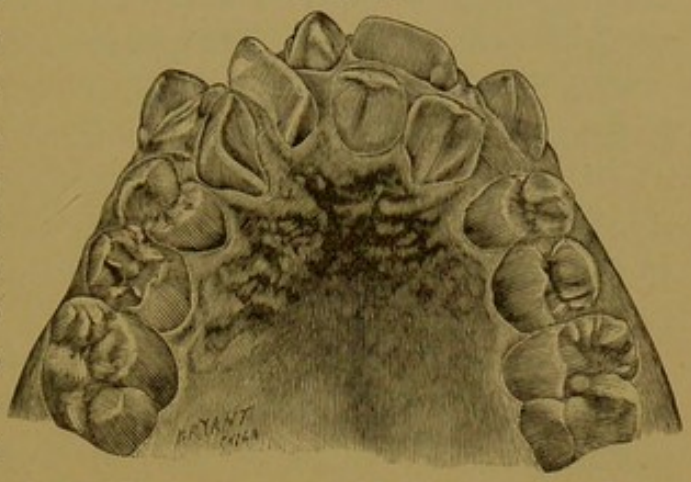
Torsion caused by Supernumerary.

Fig. 1 represents a case of this kind in the mouth of a Japanese boy, nine years of age, in which as a result of the

presence of the extra tooth, the right central is turned at an angle of 90°, while its mate is also somewhat rotated.

Fig. 2 illustrates another case more serious in character. It is that of a boy, fourteen years old, and shows a general jumbling of all of the anterior teeth due to the presence of two supernumerary laterals of regular size and form.

Fig. 2.



General Displacement caused by Supernumerary Teeth.

Sometimes the presence of a supernumerary tooth has no other effect upon the permanent set than to occupy part of the space in the arch and separate the adjoining teeth by its own width.* Even this, however, is objectionable, for in most cases the tooth, being abnormal in form, will have to be extracted and an attempt made to close the space thus created.

Accidents.—An accidental injury to one or more of the teeth of either set, whether resulting in their loss or not, is often responsible for an irregular condition. Should a deciduous tooth become devitalized, as the result of an accident or other cause, and alveolar abscess supervene, the physiological act of resorption will be suspended, and the succeeding tooth in the course of its eruption will naturally be deflected from its course and erupt in an abnormal position

So, also, it has happened that a deciduous incisor, through a fall, has been driven up into the process. Such a mis-

*A model in the museum of the Philadelphia Dental College represents two supernumerary teeth situated between the superior central incisors. None of the teeth are turned or misplaced, and but for the presence of these two intruders, the dental arch would in all respects be a typical one.

fortune can hardly fail to cause an injury to the partially formed permanent tooth lying beneath it. Should no more serious result follow, it will probably at least divert the new tooth from its course and be productive of irregularity.

The author had one such case in his practice with an irregularly placed permanent tooth as the result.

Adenoid Vegetations.—Within the past ten years the attention of oral and aural surgeons has been especially directed to the ill-effects resulting from the presence of adenoid vegetations in the naso-pharynx.

These growths are often found in children as early as the second year of life, and by partially or wholly closing the posterior nares, interfere greatly with natural breathing through the nose. They also frequently cause marked impairment of hearing by impinging upon or closing the mouth of the Eustachian tube.

It has been noticed that their presence is nearly always associated with, and by inference productive of, a pinched appearance in the superior maxillary and nasal regions of the face. This condition is believed to be attributable to lack of development of the frontal, sphenoidal and ethmoidal sinuses and the antrum of Highmore, which being normally in contact with the air, cease to develop when the circulation of the air through the nose is interfered with, resulting in altered dimensions of the face.

This lack of development in the osseous structures contiguous to the oral cavity is very likely to produce a high and contracted vault associated with a lancet-arch, and such condition of the vault and arch has usually been found in cases where adenoid growths, through lack of discovery, have been allowed to remain through a number of years.

That these growths are directly or indirectly responsible for the malposition of teeth (as has been stated by some medical writers) other than the angular position of the superior central incisors as found in the lancet-arch, we have no reason to believe; but inasmuch as any alteration

of the normal form of the arch and vault is in itself an abnormity, manifesting itself in the facial expression and perhaps seriously interfering with proper and needful occlusion of the teeth, it is very important that where the presence of such growths is suspected, a careful examination by means of the finger or mirror should be made, and, if found, the case should at once be referred to an oral surgeon.

Dr. W. A. Mills* reports a case in practice of a boy, seven years of age, in which there was almost complete obstruction of the nasal passages associated with pinched and contracted features, such as are noticed in the habitual mouth-breather. The tonsils were greatly enlarged and deglutition both difficult and painful. An examination revealed a perceptible contraction of the sides of the arch and an elevation of the hard palate. Adenoid growths were discovered and removed and the tonsils reduced in size by the galvano cautery. Six months later the tendency to contraction had disappeared, the palate and arch had resumed their normal form and the patient had greatly improved in health and appearance. The writer quotes Dr. Cryer as follows:

"It is my opinion that an inflammation of the tonsil and surrounding tissue will cause tention of the palato-pharyngeus and palato-glossus muscles; if this be so, they would naturally pull the lateral portion of the arch downward and inward; especially with children when their bones are soft and yielding."

Habits.—The bad habits which young children are apt to acquire after they are weaned, such as thumb-, lip- or tongue-sucking, are important factors in bringing about an irregular alignment of the teeth in one or more portions of the arch. Acquired early, while the temporary teeth are in position and firmly set, the habit will usually make no impression upon them, but if not checked and allowed to continue up to the time of the coming of the permanent set, as is

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sometimes the case, these will generally be thrown out of position or so altered in their relationship as to cause a serious deformity.

This is readily accounted for when we consider that the erupting teeth, seeking their position in the arch and surrounded by newly formed and pliable alveolar tissue, are easily turned out of their course by any extraneous force exerted upon them.

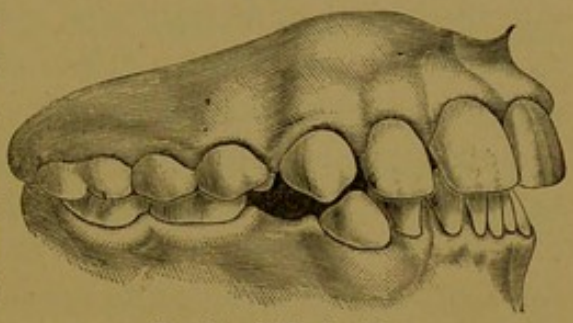
The general results of the triple habit are the same, although they vary in particulars. In thumb-sucking, usually only two or three of the incisors are pressed out of place, and the ones affected are determined by the hand used and the position of the thumb in the mouth. In lip- and tongue-sucking, owing to the larger surface of the organ employed, all of the incisors will be affected.

Not only has the point of introduction of the thumb to be considered in relation to its effects, but also the angle at which it is held. When the position of the thumb in relation to the teeth forms less than a right angle, the upper teeth will be thrown out and the lower ones in; but when held in a horizontal position, the upper and lower teeth are not displaced, but simply held apart. As a result of this the first molars are kept from present contact and naturally elongate until in time they come together. The mouth is thus permanently propped apart in front, and when the second molars erupt and come into occlusion the ill-condition is confirmed. With these eight firm teeth in contact, there is no longer any hope of the ten anterior ones elongating sufficiently to meet, and we have the deformity known as "lack of anterior occlusion," which is not only a disfigurement, but a serious disadvantage to the indvidual in mastication and speech. This lack of anterior occlusion is not always due to the habit of thumb-sucking, for it may be brought about by physical peculiarities, as noticed in Part III., Chapter IX.

In lip-sucking the lower lip is drawn into the mouth over the lower teeth and held there for varying periods both day and night. The result is that by the force thus exerted the lower teeth are thrown inward while the upper ones are forced outward to such an extent as to give them unnatural prominence and produce spaces between them.

Fig. 3 illustrates this condition. The child when brought to the author for consultation, was eleven years of age, and a confirmed victim to the habit of lip-sucking. Nearly all of the permanent teeth in each jaw were erupted and harmoniously related, excepting the protrusion of the upper and inward inclination of the lower. The teeth were brought into proper position, the appearance of the child greatly improved, and the habit, by being made impossible, was broken up.

FIG. 3.



Result of Lip-Sucking.

The displacement and failure of occlusion of teeth in the anterior part of the mouth are, however, not the only evils associated with this habit in its three forms. In each case the jaws are held temporarily apart so that there could be no occlusion of the teeth even though they articulated normally when the jaws were closed. This leaves the side teeth free to change their position if any influence is exerted to produce that result. In the act of sucking, the cheeks are drawn in and the strong pressure thus brought to bear upon the bicuspids and (occasionally) the first molars, may cause them to incline inward. In this malposition they are frequently confirmed by the opportunity thus given the other molar teeth to move forward, of which they are not slow to take advantage.

IRREGULARITIES OR DEFORMITIES WITH MIXED ETIOLOGICAL CHARACTERISTICS.

There are some typical malformations of the teeth and jaws the cause of which cannot be classed under either the hereditary or the acquired form, but combine certain features of both.

Among the more prominent of these are protrusion of the upper teeth, prognathism, and the lancet and constricted arches.

Superior Protrusion.—In this condition the superior anterior teeth project forward and outward to such an extent as to leave a space, more or less great, between their cutting edges and those of the lower, thus producing a marked deformity and giving to the individual a slightly imbecile expression. The lower anterior teeth, when the jaws are closed, may rest in contact with the bases of the superior ones, or they may impinge upon the gum tissue adjacent.

In some cases this deformity is but the expression of a tendency inherited from a progenitor under conditions favorable to reproduction, while in others it may be, and doubtless is, the result of mechanical forces finding manifestation in the individual alone. Even if inherited it must have been the result of such causes in the individual with whom it originated. In its acquired form, this abnormity may be caused by the slow eruption of the posterior teeth, which by failing to come in contact for a long time permit of an unusually long over-bite in the incisor region. The lower incisors thus occluding with the upper ones near their base have a tendency to force the latter forward and outward, these movements being favored by the thin plate of alveolar process overlying the outer surfaces of their roots. As the upper teeth move outward the lower ones, from lack of restraint, elongate until their incisal edges occupy a plane considerably above that of their fellows, oftentimes fitting into and irritating the soft tissues in the roof of the mouth.

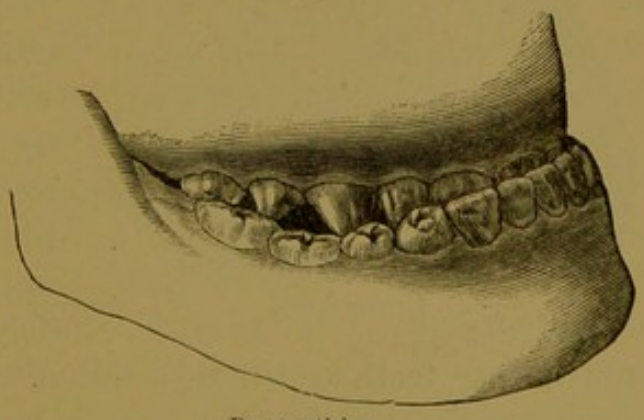
The same result is sometimes similarly brought about later in life, when through loss of several of the side or back teeth the burden of mastication is thrown upon the front ones. Lack of occlusion posteriorly and excessive pressure anteriorly will thus produce a deformity that did not exist early in life.

In some cases it may also be caused by the maleruption of certain of the posterior teeth, permitting them to assume positions in advance of or posterior to their normal places; such a condition would tend to restrain the lower teeth from pressing forward, and cause the upper ones to advance unnaturally.

The abnormity appears exaggerated in cases where from some cause the lower incisors incline inward, thus causing the upper ones to seem more protruded than they really are.

Inferior Protrusion or Prognathism.—This deformity, consisting in the abnormal protrusion of the inferior teeth and jaw, is one very frequently met with. It gives to the individual somewhat of a canine expression, and for this reason is very aptly designated by the Germans as "Hundemaul." In some cases the lower anterior teeth occlude with the superior ones, but pass outside of them, while in others the lower jaw and teeth are protruded to such an extent as to make the occlusion of the lower anterior and side teeth with those of the upper jaw a physical impossibility. Fig. 4 represents an extreme case of this character. The deformity is not only very unsightly, but interferes seriously with mastication. It is no doubt due in many cases to arrest

FIG. 4.



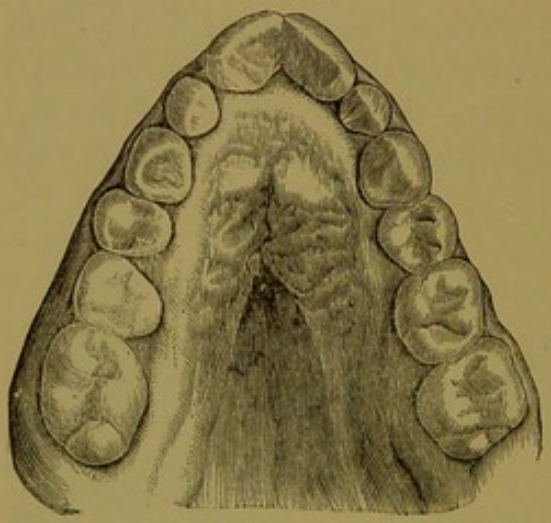
Prognathism.

of development of the superior arch, and is favored by any cause or causes that tend to lessen the extent of contact in occlusion. That the lower jaw possesses an inherent tendency to move forward when occlusion does not prevent is abundantly shown in cases where the individual has become edentulous and no artificial teeth are worn. Even the occlusion of artificial teeth will lessen or check this tendency.

In many cases it is an undoubted inheritance, while in others it may be brought about by local conditions. It is liable to occur in all cases where it is not prevented by mechanical influences.

Lancet Arch[1].—The angular or lancet arch is not an uncommon one. In a typical arch of this character, the teeth instead of forming a rounded arch, are arranged in two slightly curved and convergent lines, which meet at an angle where the central incisors join each other. The molars, bicuspids and cuspids are usually properly related to one another, but simply thrown inward, forming nearly straight lines instead of positive curves. The incisors, however, by this contraction of the space are not only thrown forward, but turned upon their axes so that their lingual surfaces present toward each other. Fig. 5 represents this form of irregularity. It is in all cases confined to the superior maxilla, the lower one being harmonious in outline. The pressing forward of the incisor teeth and their rotation often gives such prominence to the lip that the teeth remain exposed even when the jaws are closed. In addition to this unsightliness, the

FIG. 5.



Lancet Arch.

1. See "arch," Century Dictionary.

speech is often seriously affected by the free and uncontrollable escape of air when articulation is attempted.

The causes responsible for this condition are probably shrouded in greater obscurity than those of any other form of irregularity.

The crowding of teeth during eruption, delayed eruption or mal-occlusion, some of which are evidently responsible for many forms of irregularity, cannot be called to account for this condition, for none of them could press the teeth into such symmetrically straight lines. Mr. Charles Tomes believes that it is brought about by the pressure of the muscles of the cheeks upon the sides of the arch while sleeping with the mouth open, and that this habit is due to enlargement of the tonsils, which prevents full breathing through the nose.

The pressure of the cheeks covering so large a surface would be just the kind of force likely to produce this symmetrical contraction of the arch, but we are confronted with the fact that in mouth-breathing the jaws are never held far apart, and also that the masseter and buccinator muscles, owing to their points of insertion, stand clear of the teeth, so that even when somewhat flexed, they could not possibly produce pressure upon these organs.

The condition is nearly always associated with a high and narrow vault, and it may be possible that both of these features have been brought about by imperfect development of adjacent parts, especially of the vomer, which stands in the relation of a pillar or support to the palate.

Constricted Arch.—This deformity, though less common than the preceding one, and giving less external evidence of its existence, is far more likely to favor decay on account of increased surface contact. In seeking an explanation for its existence, it is well to remember that the bicuspid teeth (the ones most usually affected) are situated immediately beneath the deciduous molars, and succeed to their positions. As the first set occupies an arch in every way smaller than

the permanent one, the position of the bicuspids would locate them inside of the arch described by the permanent teeth already in place. When there is no obstacle to prevent, they naturally move outward into place; but where insufficient space does not permit this, they are obliged to remain where they are, or in an effort to force their way into line, assume a crowded and irregular position.

The fact that when bicuspids are out of line they are nearly always found to be inside of the arch seems to favor the supposition that the irregularity has been brought about in the manner suggested. Early eruption of the cuspids and tardy eruption of the bicuspids would also favor the condition.

The assumption that bicuspids once in line may be forced out of it by pressure exerted in the eruption of the second and third molars has little to support it. Were this possible or probable the deformity would be more frequently met with. Fig. 6 is a fair representation of this deformity. Both sides of the arch are not usually affected to the same extent, and in some cases the two bicuspids on one side occupy a position directly across the arch, each one being partly turned upon its axis.

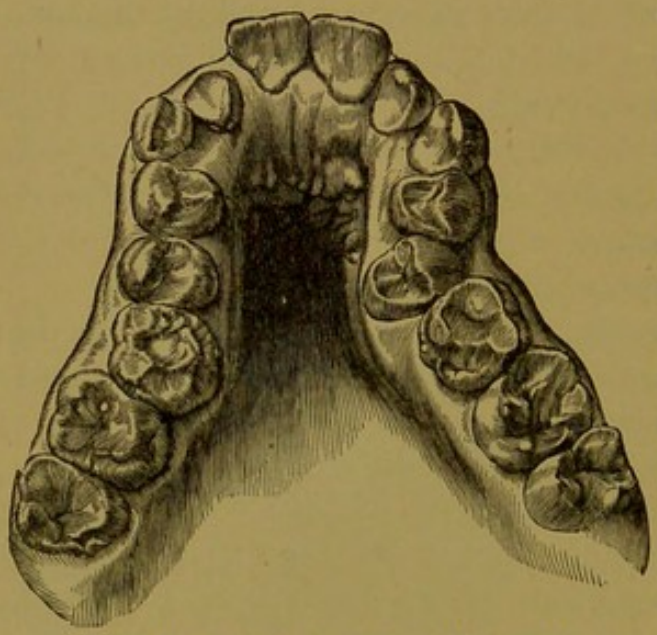


FIG. 6.—Constricted Arch (*Coleman*).

The condition is rarely met with in the lower jaw, and is one, according to the author's observation, never inherited, but always acquired.

CHAPTER III.

EVILS RESULTING FROM IRREGULARITY.

In order to properly appreciate the importance of correction of irregularity of the teeth, it will be well to consider in brief detail some of the more prominent evils associated with the condition.

Appearance Marred.—While this result is usually not the most important of those connected with irregularity, it is the one which most generally induces the patient to apply for remedial treatment. The other evils may not be recognized, or may be considered of minor importance by the parent, but the ill-appearance of the child both attracts the attention and enlists the sympathy to such an extent as to create a desire for its improvement.

The external deformity caused by an irregularity will be greater or less according to its extent and location. If it be slight in character and located back of the cuspid teeth, it will usually give no external evidence of its existence, but if located in the anterior part of the mouth, it will, even if slight, be very noticeable and in consequence constitute a source of annoyance to the individual throughout life.

The class of irregularities most noticeable under all conditions is that where the form of the arch is altered, thus changing in a marked degree the entire facial expression. Such deformity cannot be masked. It must either be mechanically reduced or stoically endured.

Speech Affected.—This result like the preceding one will be slight or aggravated according to circumstances, but when at all considerable it proclaims itself to the world with every attempt at speech in so unpleasant a manner as to be a painful annoyance to both speaker and listener.

It may be due to restriction of the movements of the tongue as in a narrow or contracted arch, to alteration of the form of the roof or vault of the mouth where the sides of the latter have assumed a deep pitch resulting in the formation of a sharp angle along the median line of the palate, or, it may be, and most usually is, due to the uncontrollable escape of air between the teeth in the anterior part of the mouth by virtue of the non-occlusion of those teeth and the change of form in that part of the alveolar ridge which aids the tongue in the production of perfect sounds.

Mastication Impaired.—In most cases of irregularity, either simple or complicated, there is a corresponding degree of either mal-occlusion or lack of occlusion. In simple cases, or where but few teeth are thrown out of occlusion, it may not occasion any inconvenience to the individual, but where the irregularity is at all extensive so many teeth are usually lacking in occlusion as to seriously impair the power of mastication.

When this latter condition prevails it is most likely to result, sooner or later, in injury to other organs, for where mastication is imperfectly performed greater demand is made upon the stomach in preparing the food for assimilation. The stomach soon feels the effect of this over-taxation and becomes weakened in tone, which may finally result in incapacitating it for the performance of its normal functions.

Teeth that do not occlude are of no use to the individual for purposes of mastication, and those that occlude but slightly or imperfectly possess very slight value.

As one of the principal functions of the teeth is mastication, and as all the teeth are needed to perform this work satisfactorily, it naturally follows that any interference with this function, through irregular position or otherwise, must be detrimental to the individual and may result in partial or complete loss of health.

Caries Induced.—The human teeth are arranged in the jaws in such manner as to best subserve the wants of the individual, and their form and location are also such as to conduce to greatest immunity from caries and longest service.

Their rounded approximal surfaces and the constriction of their necks reduces the points of contact with their fellows to the minimum. As their liability to approximal decay is in proportion to the amount of surface in contact, it will be seen that those normally placed are likely to be freest from the ravages of caries.

When, therefore, the teeth occupy irregular positions, especially where they are crowded, more of the surface of each tooth is in contact, and the liability to decay is correspondingly increased. This is true of irregularly placed teeth in any part of the arch, but the liability is greater where crowding or overlapping exists among the incisor teeth, for owing to their flattened form it is possible for more of their surfaces to be in contact with their fellows than would be possible with any of the other teeth. In such cases, with the condition uncorrected, teeth decay and re-decay in spite of the most faithful efforts of the dentist, until they are finally lost.

CHAPTER IV.

ADVISABILITY OF CORRECTION.

With our present knowledge in regard to the teeth and their surrounding tissues, and the advancement made of recent years in the multiplication and perfection of mechanical appliances, scarcely any deformity of the mouth and teeth is beyond mechanical remedy. With possibility assured, however, it is most important that we should consider carefully the question of advisability, for what is possible may not always be advisable. There are several considerations that enter into this question of advisability.

Age.—The age of the patient has much to do with the advisability of any proposed operation for correction. Early in life, when the alveolar tissues have not yet reached the hardness and density of structure which they will attain at a later period, they are more easily operated upon. They are elastic and readily yield to pressure, and at the same time under the influence of this pressure they are more quickly resorbed or bent and thus give way to the tooth that is being moved. This feature of early youth is an important and valuable one in that it renders an operation for correction more easy of accomplishment, but while the soft and easily yielding process favors the operation, it is at the same time a tissue poorly fitted to resist the influences which often operate to again displace the tooth. For this reason, a tooth moved at an early age may be liable to subsequent displacement when the pressure caused by the eruption of the succeeding teeth is brought to bear upon it.

After maturity we have the conditions exactly reversed. The denser and more perfectly calcified process yields less readily to pressure and resorption, but when the tooth has

once been moved into proper position it is more easily and firmly held there by the surrounding tissues.

In view of these facts it will readily be seen that in many cases, especially where the proposed operation is simple in character and where the result obtained is not likely to be nullified by subsequent events, interference early in life is advisable; but where the operation is to be extensive in character, and especially where we have reason to doubt our ability to retain the results secured, prudence would suggest non-interference until fourteen teeth of the involved jaw have erupted.

Health.—The health and strength of the patient at the time of any proposed operation for irregularity is so important a consideration that it dare not be disregarded. The time that is generally considered most favorably for correction (between the ages of twelve and eighteen years) is also a period when important changes are going on in the entire economy. The individual is passing from the stage of childhood into that of manhood or womanhood, and in this change, especially in the case of the female, the life-forces are taxed to the utmost. At this time also the mental faculties are being severely strained by study, in consequence of which, if the physical culture of the individual be neglected, as it too often is, the nervous system becomes unduly exalted.

To meet and partially compensate for these drains upon the system it is most important that full nutrition be sustained. To do this with teeth that are sore or tender to the touch from being moved is impossible, and hence the system will be still further weakened by lack of nourishment if any severe operation be undertaken.

At this period of life, therefore, unless the patient possesses vital powers of a high order, it might be unwise to further tax the system by any extensive operation for correction that would involve the infliction of much pain, discomfort or annoyance. Should the vitality of the patient

be below the average, no difficult or protracted operation for correction should be undertaken, for it might result in permanent impairment of the health.

It is much better to postpone the operation until a time when the vital powers can stand the strain or if necessary abandon it altogether, for the loss of health can never be compensated for by any benefit conferred upon the dental organs.

Sex.—The sex of the individual must also be considered in connection with this subject. The consideration of sex may be disregarded so far as the desirability of an operation is concerned—for if the results of neglected irregularity are harmful in respect to one sex, they are certainly equally so in regard to the other—but as regards the necessity for interference the question of sex is an important one. Correct facial expression and harmony of feature are far more important to woman than to man; for, being endowed by nature with greater beauty of form and feature, its absence in any part is more noticeable than it would be in the sterner sex. Besides this, after youth is passed, man has in the hairy covering of the lip a means of concealing most deformities of the dental arch, while woman is entirely without this advantage. For these reasons the necessity for the correction of any irregularity of the teeth seems more imperative in woman than in man.

Power of Appreciation.—The intelligence of the patient and his ability to properly appreciate any benefit conferred, are important considerations in enabling us to determine whether or not to undertake any considerable operation for the correction of irregularity. At best it is a most difficult undertaking, and frequently lacking in suitable pecuniary reward, so that the lover of the art must nearly always depend upon appreciation for part of his compensation. If this be wanting, the operation is robbed of nearly or quite all of its attractiveness, and the stimulus to success is absent.

There are those whose want of intelligence or lack of culture would lead them to regard with much indifference any irregularity of their teeth, and who if benefited by our efforts for correction would fail to appreciate it. For such manifestly it would be unwise to urge or encourage any difficult or extensive operation for correction even though they might be able to compensate us pecuniarily for our labor, for they would be likely either to abandon the operation when partially completed or fail to wear any appliance for retention, and thus permit failure to follow success.

Family Type.—When any great deformity of the teeth and jaws, such as anterior protrusion of either jaw or a lancet arch is shown to be hereditary, it is well to take into consideration this feature of the case before beginning any operation for correction. Where the irregularity is known to have been acquired in the parent of the child and thus to have been transmitted but once, the difficulties in the case are not so marked because the type has scarcely been confirmed; but where it has been transmitted through two or more generations the impress is strong and difficult to overcome.

In the latter case the correction of the deformity will not be more difficult than usual, but after correction the tendency of perverted nature to cause a return to the family type will be so strong as to almost baffle us in our attempts to preserve the advantage we have gained. Under such circumstances the retaining appliance will have to be worn a very long time, and a constant watch kept over the case until we are sure that the result will be permanent.

Improvement of Occlusion.—Faulty occlusion is always necessarily associated with irregularity and is one of its most objectionable features. While mastication may be performed to the satisfaction of the individual where an irregularity exists, it can neither approach the ideal of nature nor properly subserve its own ends unless the teeth occlude in a normal manner. It would be difficult to find a set of teeth

in which the occlusion is all that could be desired, but the nearest approach to it is what we should strive after. Therefore, in considering the advisability of correction in any given case, we should carefully study the existing conditions and endeavor to ascertain in advance whether, when we have improved the arrangement of the teeth, we have also improved the articulation.

Dr. Davenport says: * "In the treatment of our patients, it is hoped that if we cannot all see our way clearly upon this matter, we may at least see far enough not to make the occlusion worse by our operations than they were when brought to us."

"Much harm is done by the use of regulating appliances which change the occlusion without improving it, and it is almost a universal fact that unless an improvement can be made in the occlusion, there will be no permanent improvement in the irregularity."

* International Dental Journal, Jan., '92.

CHAPTER V.

AGE AT WHICH CORRECTION MAY BE BEGUN.

The correction of irregularities, under favoring conditions, may be begun and carried forward successfully through a wide range of years.

It may be undertaken as early as the eighth or ninth year, and again may yield successful results as late as the thirty-fifth year or later. The operation is one largely dependent upon the resorption and reformation of alveolar tissue, and as new bone will form at almost any period of life, as evidenced by the union of a fracture, so the correction of an irregularity is possible at quite a late period.

The operation, however, would usually prove so slow and tedious after the maximum of density has been attained in the alveolus, and the necessity for it be so much lessened by advancing age, that the advisability of undertaking it would be questionable.

When Early Interference is Justifiable and Advisable.—Any of the permanent teeth may erupt outside or inside of the arch. If allowed to remain in such position for any length of time, the space intended for their accommodation will soon be partly occupied by the adjoining teeth, and the subsequent correction of the irregularity rendered more difficult. A central or lateral incisor often erupts in such a manner that its incisal edge, instead of being in line with the curve of the arch, forms an angle with it.

This torsion may be associated with an overlapping of the adjacent tooth as shown in Fig 7, or there may be a space between the two as shown in Fig. 8.

In either case the turned tooth occupies a less space in the line of the arch than it should. By allowing this con-

dition to remain, when the pressure of the later erupting teeth begins to be felt, these teeth will be pressed still closer together and the irregularity be confirmed. Subsequently, when the correction of the condition is attempted, there will not be sufficient room to accommodate the tooth in its wider aspect and the adjoining teeth will have to be pressed apart or the arch expanded to obtain the necessary room; whereas, if the tooth had been turned in its socket before the eruption of the other teeth the operation would have been a very simple one.

Fig. 7.

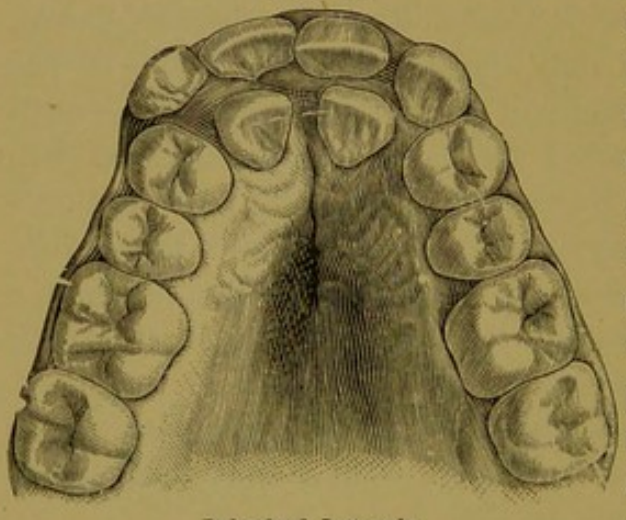
Torsion and Overlapping.

Fig. 8.

Torsion with Space.

Again, when an incisor erupts so as to occupy a position inside of the line of the arch in the upper jaw, or outside of it in the lower, and the tooth be held in such position by the opposing teeth, immediate interference and correction is demanded in order to prevent the complications that would result from the partial or complete closure of the space intended for the accommodation of the malposed tooth.

Fig. 9.



Inlocked Laterals.

Fig. 9 shows a case of this character with both laterals inlocked. The superior central incisors sometimes erupt with their incisal edges forming an angle at the median line. To neglect the condition or to postpone its correction would not only result in its confirmation and probable aggravation, but might also open the way for a complete change in the shape of the arch. Fig. 10 illustrates this condition.

It is entirely probable that certain arches of a modified lancet shape have been formed in this way. In cases such as those just mentioned, early interference is the wiser plan, but it is equally important that after the teeth have been placed properly in line they should be firmly held, not only until new bony tissue has been formed around them, but until the lateral pressure of the neighboring teeth coming into place has spent itself.

FIG. 10.

Torsion of both Centrals.

In the lower jaw the conditions are somewhat different. The incisors, upon eruption, generally assume a somewhat crowded and irregular position, which is partly or entirely corrected by nature in the enlargement of the arch and the influence of the lip and tongue in bringing them into a more harmonious outline.

Interference with them when they are within the arch is not usually called for until a later period.

While there are many practitioners who have long held the view that early interference is inadvisable in the great majority of cases, the large experience of others who have made a specialty of this branch of practice has led them to declare in favor of early correction.*

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* "As soon after eruption as it becomes certain that an irregular denture is inevitable, there is no longer justification for delay, and after that period every year increases the difficulties, both mechanical and pathological, and prejudices the stability of the dental apparatus. . . . The author has not hesitated to undertake treatment of very extensive irregularities, even while teeth were emerging from the gums."—Kingsley—Oral Deformities, pp. 61, 62.

"It is the opinion of the writer that each tooth should be encouraged to take a correct position in the circle of the arch while erupting (or as soon thereafter as practicable), in order to promote the proper development of the jaw, for the teeth next to be erupted are thus more likely to do so in proper position and order."—Jackson—Trans. Amer. Dent. Assoc., 1890, p. 201.

"I believe the best time to begin the treatment is as soon as the appearances of irregularity are manifest, then, with delicate and simple appliances,

Certainly where the case is brought to our attention in its incipiency we can frequently by judicious management and the application of slight corrective measures either counteract or greatly modify any tendency toward irregularity.

A feature favoring early correction is that the roots of the teeth are not fully calcified until a long time after their eruption. Until fully calcified the apical foramina are large and more than accommodate the nutrient vessels entering the tooth, so that there is less danger of devitalizing the pulp through strangulation in the movement of a tooth at this period than later.

When Correction Should be Delayed Until Dentition is Complete.—In some cases an extensive operation for the correction of irregularity involving a number of teeth should not be undertaken until all of the permanent teeth (excepting the third molars) are fully erupted. When but a few teeth are malposed with no prospect of their being able to take their places in the arch unaided, and every prospect of their being confirmed in their malposition, the necessity for immediate interference is plainly evident; but where a large number of teeth are malposed it is not so easy to prognosticate what effect their correction may have when considered in relation to the teeth still to be erupted. The result is

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gradually assist the tooth to take its natural position. . . . A few days with a proper appliance will often accomplish what may require many months if left until the whole dental apparatus is involved."—Angle—Pamphlet, p. 50.

"Early interference is often necessary, as where the superior incisors erupt slightly posterior to their natural position and occlude with the cutting edges of the lower ones. Should the superior incisors not be moved forward as soon as this tendency is noticed permanent prognathism might result. Correction should be commenced as soon as appliances can be used to advantage."—Goddard—MSS.

"As soon as a tooth (or a number of teeth) erupting show such misplacement that natural conditions will not make it self-correcting, mechanical means should at once be resorted to—no matter what the age. The only condition that would not justify such interference is ill-health."—Matteson—MSS.

naturally involved in some doubt. Even if the necessity for correction appears evident to us and we should accomplish it, the final result may not be all that we had hoped for.

Under such circumstances it is wise to delay interference until the permanent teeth are in place and the arch fully expanded, when by a careful examination of all the conditions we can easily foresee the result of any proposed operation and decide intelligently not only what needs to be done, but also the best way of accomplishing the desired result. Oftentimes this later examination will show that the irregularity has much improved and the necessity for interference is consequently lessened.

The line of distinction between the advisability of early and late interference is not always plainly marked, but where there is no very evident reason for delay prompt interference is the safer and better plan.

CHAPTER VI.

EXTRACTION AS RELATED TO ORTHODONTIA.

Probably no operation in the practice of Orthodontia is more important, or has associated with it greater possibilities for good or evil to the patient than that of extraction.

As related to the prevention or correction of irregularity, extraction on the one hand may be of the greatest possible benefit or on the other it may result in irreparable injury.

Judicious extraction, if undertaken in time, will often forestall or prevent an irregular condition of the teeth, and in other cases it will assist greatly in simplifying the operation of correction. Occasionally, it is all that is called for on our part, nature performing the rest of the operation unaided.

Injudicious or ill-advised extraction, however, may complicate and render most difficult the correction of cases which in themselves were not difficult, or it may even be the immediate cause of a deformity which would not otherwise have existed.

The paramount importance, therefore, of knowing when to extract, and when not, will be readily recognized.

In order to give the student a fair idea of the determining conditions in as concise and comprehensive a manner as possible, it has been thought best to formulate the following rules:

RULE I.—*Avoid, if possible, extracting any of the six anterior teeth in the superior arch.*

We would urge this, because it is nearly always unnecessary to extract them, and because their absence, owing to

their prominent position, would be more noticeable than that of other teeth in the mouth. If the anterior teeth be sound and only irregular, the extraction of a bicuspid from one or both sides will usually give us sufficient room for spreading the anterior teeth and moving them into their proper positions.

It has happened, however, to the author and others, to meet with cases where the superior laterals were locked inside the arch by the close approximation of centrals and cuspids, and where the laterals were withal so badly injured by decay and disease as to render their usefulness doubtful if brought into line. In such few cases it was deemed best to extract the laterals, especially as their absence would not be more noticeable afterward than before, and because there was good occlusion between the rest of the teeth in the mouth.

The author had two unusual cases present to him in one year for the reduction of protrusion of the superior anterior teeth. In each case there was a broken or badly diseased right central incisor that was beyond hope of preservation. In these cases it did not happen particularly amiss, for the extraction of the roots afforded room for drawing in the remaining five teeth, thus easily reducing the deformity and at the same time closing the space. The appearance of the patient in each instance was greatly improved, and the absence of even so large a tooth as the central was scarcely noticeable.

It must be borne in mind that in the cases just mentioned advantage was simply taken of an existing condition to simplify an operation. Had the teeth been good, the proper plan to pursue would have been to extract a bicuspid on each side and retract the anterior teeth.

In another case, a girl eleven years of age had lost a superior right central incisor through a fall from a swing. Two days after the accident, and when the tooth had been mislaid or thrown away, she was brought for treatment. Only

two methods of remedying the difficulty suggested themselves. One was the wearing of an artificial tooth; the other, drawing the teeth together to close the space. The latter plan was decided upon, and successfully carried into effect; but, unfortunately, as there had been no protrusion before and there was contraction afterward, the superior teeth no longer overlapped the lower ones, but met them edge to edge, thus giving the upper jaw a flattened appearance, which was in itself a deformity. The patient was saved the annoyance of wearing a plate, but her facial expression was injured in consequence.

Such cases as those just described are exceedingly rare, and are only mentioned as extraordinary exceptions to a very good rule. Aside from the centrals, there is probably less excuse for the extraction of the cuspids, than any of the anterior teeth, and yet it is, unfortunately, too often resorted to.

If for any cause the cuspids erupt abnormally, and there is no room for them in the arch, if it be not advisable to expand the arch, one of the teeth on each side should be extracted to make room for them.

The decision as to which tooth to extract (where extraction is deemed best) in order to allow an outstanding cuspid to be brought into line will be largely governed by the position that this tooth occupies. If it be situated in a line between the lateral and first bicuspids with its root sloping backward, the bicuspid would be the proper tooth to extract. If, however, the slant of the root be forward the lateral incisor should be removed, because in drawing the crown of the cuspid forward to occupy the place of the lateral, it would be made to occupy a more nearly vertical and normal position. To move the crown of a cuspid forward when it already inclines forward, or backward when it points that way, would cause it to present such an oblique appearance as to be very unsightly.

RULE II.—*In the lower jaw one of the incisors may sometimes be extracted to gain space.*

Slight irregularity or crowding of the inferior incisors is of such common occurrence as to have almost become the rule instead of the exception. Their partial concealment, together with the usual freedom of the condition from ill results, causes any interference to seem meddlesome rather than otherwise, if the irregularity be trifling. In cases, however, where the crowding is excessive and calls for correction, it is usually the easier and better plan to extract one of the implicated teeth and bring the others together into line. The four teeth are so nearly alike in size and appearance, that when one has been removed the loss is not usually noticed. It is sometimes perplexing to decide which of the four to extract, but the one most out of line, and in consequence the one which will create the least space by its removal, should usually be selected.

In respect to the loss of the inferior cuspid, the same remarks apply as to its fellow in the opposite jaw.

RULE III.—*Back of the anterior teeth, if all are equally good and one must be removed, select the one nearest and posterior to the one out of position.*

As so large a proportion of the irregularities we are called upon to correct pertain to the anterior teeth, and as it is so important to retain these, extraction for room, when necessary, generally falls upon one of the teeth posterior to the cuspids. Which of these it is best to extract, to make room for a malposed cuspid or incisor, has been a subject of controversy among practitioners for many years.

Some have claimed that as the statistical tables show the first molar to be by far the least durable of all the permanent teeth, it should generally be selected as the one to be sacrificed. Others, on the contrary, have contended that as the first and second bicuspids are both frail teeth, and are

often lost early in life, and as from its greater size the first molar is so much more valuable in mastication, it should be preserved and one of the bicuspids removed.

There is truth in both of these arguments, but we feel satisfied that under the conditions named, (all equally good at the time,) wisdom will dictate the removal of the one nearest the point of difficulty, for in so doing we greatly simplify the operation for correction and effect a saving all around. Simplicity in surgical as well as mechanical matters is a great desideratum. Indeed, it not infrequently happens that where a cuspid is out of line the first bicuspid has usurped its place in the arch, so that if we were to extract the first molar, both first and second bicuspids would have to be moved out of their positions of good occlusion into a space farther back, a feat very difficult and oftentimes well-nigh impossible of accomplishment. By the simple extraction of the first bicuspid in such cases, the cuspid will usually fall into its place without any assistance.

In certain cases where there is nearly but not quite sufficient space in the arch to accommodate an outstanding cuspid, and where the occlusion would not contra-indicate such action, it is better to extract the second bicuspid instead of the first, because the surplus space thus created will then be back of the first bicuspid, and consequently less noticeable than it would be in front.

RULE IV.—*If a tooth other than the one nearest to that in malposition be defective, and not too far distant from point of irregularity, extract it instead.*

The second molar, decayed or sound, is usually too far distant to be available by its extraction in furnishing room for the movement of anterior teeth. If the bicuspids be sound and the occlusion does not interfere with their backward movement, the first molar, if very defective, may be extracted in preference to a sound tooth in advance of it.

If the second bicuspid be badly diseased and the first one healthy, the former may be extracted instead.

With our present methods of restoration, however, it will seldom be necessary to condemn and extract any tooth on account of extensive caries, for by proper crowning, it can be restored to usefulness for a great number of years.

RULE V.—*If a tooth must be lost, either to allow a more important one to fall into line or to create space, it should be done without delay to accomplish the best results.*

When a cuspid erupts without room in the arch for its accommodation, and the circumstances of the case point to the extraction of the first bicuspid to make place for it, the sooner the extraction takes place the better. If the operation be delayed, the cuspid in its endeavor to force its way into place will often press so hard upon the lateral as to force it inward and if possible under the central, thus creating an additional irregularity. Such results have often been noticed. Prompt extraction after it had become necessary would have changed the condition.

In similar manner, when it becomes advisable to extract one or more of the first molars to prevent the further expansion of the jaw or to abort a threatened irregularity in the anterior part of the arch, it is best not to delay their extraction too long. They should not be extracted before the second bicuspids are in place, but if they must be lost, they should be removed after the eruption of the latter teeth and before the second molars appear, somewhere about the eleventh or twelfth year. If longer delayed the harm we wished to prevent (expansion of the jaw) will have been accomplished and their later extraction will not avail. If extracted about the time the second molars are erupting, the latter will naturally glide into the space formerly occupied by the extracted teeth; this they are not so apt to do later.

RULE VI.—*If a tooth must be removed on one side to obtain space it does not follow that its mate on the opposite side should also be extracted.*

If there be the same reason for extracting both, as where the existing evil pertains as much to one side as to the other, let both be extracted; but where the trouble sought to be remedied is confined to one side, the extraction of a tooth on that side ought not to be supplemented by a useless extraction on the other. Those who favor symmetrical or double extraction claim that it prevents the disturbance of the median line, but it has been our experience that the extraction of a tooth back of the cuspid will not often affect the central line through the moving of the teeth toward the space, and even a slight disturbance of that line is far less objectionable than the sacrifice of a valuable tooth. A correspondent mentions a case in which, after a long struggle to save the badly decayed superior first molars of a Miss, 14 years of age, he determined to extract them. After three months the girl returned, and it was noticed that the superior centrals had separated one-eighth of an inch. He adds, "since that time I have refused to extract symmetrically in growing subjects."

RULE VII.—*Where there is disparity in size between the two jaws, and two teeth need to be extracted from the more prominent one, it would be a serious mistake to extract the corresponding teeth in the other and smaller jaw.*

It would seem almost impossible to make such a mistake and yet that it has been made time and again, the mouths we are called upon to examine often bear sad evidence. It occurs through lack of knowledge, want of judgment, or erroneous teaching.

When those of long practice advise, without qualification,

that at eleven years of age the four first molars should be extracted, it is scarcely to be wondered at that some young practitioners should lose confidence in their own better judgment and be led astray. Harm of this nature, when once done, can never be undone, and the patient is injured beyond remedy.

RULE VIII.—*Needless extraction should be carefully guarded against.*

It is our object to save and improve, not to destroy. Extraction should only be resorted to when it appears, after careful consideration, to be the best or only way of accomplishing the object in view. Ill-advised extraction of the molars or bicuspids has often been the cause of a very serious and irremediable form of deformity, namely:—the separation of the anterior teeth, leaving unsightly spaces between them, thus depriving them of natural support and leading to their earlier loss.

When teeth, especially the first molars, are extracted at a later period than they should be, leaving a space that the second molars cannot occupy, the teeth anterior to the space will fall back unless prevented by the occlusion. If this falling back pertains only to the bicuspids, no harm will usually result, but if it extends to the anterior teeth, as it may, and often does, the result will be disastrous. In this connection we cannot help again emphasizing the necessity for the removal of first molars (if they are to be removed) before the second molars have assumed their place in the arch.

CHAPTER VII.

PHYSIOLOGY OF TOOTH-MOVEMENT AND CHARACTER OF TISSUES INVOLVED.

In changing the position of teeth in the act of regulating, the surrounding tissues, both hard and soft, are largely involved.

In order, therefore, to properly comprehend the philosophy of tooth movement, it is necessary to understand the structural character of these tissues and the physiological changes that take place in them while a tooth is being moved.

The Alveolar Process.—This process, as its name implies, is not a separate and distinct bone, but an outgrowth from another. It is a provisional structure designed to support the teeth in position and afford lodgment for the nutrient vessels leading to them. It is formed upon the body of the bones of the jaw as the teeth are developed, growing with them until they are fully formed, and then remaining while they remain.

When the teeth are lost, there being no longer any special use for it, most of this process is resorbed and carried away. In early infancy little alveolar structure exists, but it is formed co-ordinately with the growth of the deciduous teeth and remains during the period of their retention. Should they be lost before their successors are ready to appear, the process will be entirely removed by resorption, and a new one formed for the accommodation of the permanent teeth. Where, however, the deciduous teeth are gradually shed to make way for their successors, the process is not entirely resorbed, the basal and unabsorbed portion serving as a foundation upon which the new structure is formed.

The alveolar process, being built or formed upon the body of the maxillary bones, conforms to them in outline and

describes the same curves. In depth it corresponds to the length of the roots of the teeth, while in width it is sufficient to envelop all of that portion of the tooth beyond the termination of the enamel. It gradually increases in thickness as it approaches the body of the bone upon which it rests.

It consists of an outer and inner plate united at intervals by septa, thus forming alveoli for the accommodation of the roots of the teeth. Its main portion is not compact, but open and spongy, resembling the cancellate structure of the diploë of the bones of the cranium and the inner portion of other bones. Its outer or cortical layer is very dense and hard, and therefore offers greater resistance to the moving of a tooth than the more open structure beneath. Its cellular structure, while giving it sufficient firmness to assist in supporting the teeth in their positions, affords opportunity for the lodgment and passage of the vessels of nutrition and sensation with which it is so bountifully supplied.

Owing to its peculiar structure and great vascularity, the alveolar process is readily resorbed under the stimulus of pressure, and as readily reproduced behind the moving teeth.

The Teeth.—Of the teeth themselves little need be said. The student is familiar with their number, shape, position and structure. Being the most compact organs of the human body, the application of any force necessary to their movement will not injuriously affect them so far as their hard tissues are concerned.

The ease or difficulty with which they may be made to change their positions is dependent upon the number and length of their roots and the thickness of the process surrounding them. All of the superior teeth can be more readily moved outward than inward, on account of the thinness of the external alveolar plate. The ten single-rooted teeth in the lower jaw may be moved outward or inward with equal ease, while the lower molars are more readily moved inward.

All of the teeth can be more easily moved in the line of

the alveolar arch than outward or inward, because the septa are composed almost entirely of cancellate tissue which yields readily to pressure and is quickly resorbed.

The Pulp.—The pulp is the formative organ of the tooth, and after calcification is complete it remains as the principal source of nutrient supply for the dental tissues, especially the dentin.

It is composed of fibrous connective tissue, containing a delicate system of lymphatics together with numerous nerve filaments which enter through or near the apical foramen. Ramifications of minute blood-vessels are noticeable throughout its whole extent, giving color to the organ and constituting its vascular system.

It bears an important relation to the teeth in their movement, since it may be readily devitalized through imprudence or lack of care. Before calcification of the teeth has been completed the apical foramen is large and easily accommodates the pulp where it enters the tooth. After calcification is complete the apical foramen is small, and the pulp at this point is in consequence greatly reduced in size. In the ordinary movement of teeth there is generally a mechanical constriction of the pulp at the apex due to the tipping of the tooth in moving. If the movement be rapid in teeth fully calcified (after the sixteenth or eighteenth year) this constriction may be so great as to cause death of the pulp through strangulation. Before complete calcification this is not likely to occur, from the fact that when the foramen is large the pulp has more space for its accommodation.

In the movement of a tooth in the direction of its length the pulp may become devitalized through excesssve stretching. This has occurred at times in drawing down into line a tooth that has been retarded in eruption. In all such cases care must be exercised and the movement conducted slowly.

The Pericementum—The pericementum or peridental membrane is that tissue which envelops the root of the tooth

and fills the space intervening between it and the alveolar wall. It is a tough, strong membrane, composed mainly of fibrous connective tissue, permeated with blood-vessels and nerve fibres, and containing traces of a lymphatic system.

It is strougly adherent to the alveolar wall of the socket on the one hand, and to the cementum of the tooth on the other, its adherence being due to the extension of its fibres into both the bone and the cementum. These fibres, according to Prof. Black,* "are wholly of the white or inelastic connective tissue variety," and the apparent elasticity of the membrane is due to the passage of most of the fibres from cementum to wall in an oblique direction, in such a way as to "swing the tooth in its socket."

This membrane is the formative organ of the cementum of the tooth, and also assists in building the walls of the alveoli.

The cells concerned in the building of the bony walls are known as osteoblasts, and those forming the cementum are designated cementoblasts. After these cells have performed their normal function, they become encapsuled and form part of the tissue they were instrumental in building.

When re-formation of tissue is demanded, as in the thickening of the alveolar wall, or in increasing the normal amount of cementum at various points under certain conditions, new cells are originated to perform the work. In the moving of a tooth the activity of these new cells is at once manifested in the formation of alveolar tissue to fill the space caused by the advancing tooth.

Beside these cells of construction and repair, the pericementum also contains cells that might well be called *cells of destruction*. They are the osteoclasts or cementoclasts, and their function is to break down or resorb the cemental or osseous tissues when nature calls for such action.

In the correction of irregularities these cells perform valuable service in removing bony tissue in front of the moving tooth.

* Dental Review, vol. I., p. 240.

The pericementum is thickest in childhood, when the sockets or alveoli are of necessity considerably larger than the roots of the teeth which they contain. With advancing age both cementum and the alveolar walls are increased in thickness by slow but continuous growth until the pericementum is greatly reduced in thickness, and in consequence the diameter of the roots more nearly approximates that of the alveoli or sockets.

The pericementum possesses a variety of function not often met with in any single tissue of the human system.

It retains the tooth in its socket and acts as a cushion to prevent injury to the adjoining bony structures from hard and violent concussions to which the teeth are sometimes subjected.

It affords accommodation for numerous blood-vessels which supply both the teeth and alveolar tissue with nutrient material, and for the branches of nerves which constitute it the sensory organ of the tooth, so far as tactual impress is concerned.

It is the organ of construction and repair of both cementum and bone, and is also, on occasion, the organ of destruction of either or both of these tissues.

Physiology of Tooth Movement.—In the ordinary movement of teeth one or both of two changes take place. One is the resorption of alveolar tissue on the advancing side of the tooth and its reformation on the opposite side, and the other a bending of the alveolar plate in the direction of the applied force. The cancellate tissue is easily compressed and resorbed in response to pressure, but the cortical layer of the process offers greater resistance and is less readily resorbed on account of its density.

Where the cortical layer is very thin at the alveolar border as on the labial side of the superior anterior teeth, and on both the labial and lingual sides of the inferior anterior teeth, it is, of course, more easily bent than in the region of the posterior teeth where it is thicker. For this reason

the superior anterior teeth yield most readily to force applied in an outward direction, while the anterior teeth of the lower jaw yield almost equally to a force directed either outwardly or inwardly.

When force is exerted upon a single tooth for the purpose of moving it, the first effect produced is the compression of the pericementum between the tooth and alveolar wall on the advancing side, and the stretching of the same membrane on the opposite side. In the compression of the membrane the blood supply is partly cut off, and the nerves, by their irritation, create a sensation of pain which is soon obliterated by the semi-paralysis brought about by continued pressure. At the same time this irritation stimulates and hastens the development of the osteoclasts which at once begin the work of breaking down and resorbing that portion of the socket pressed upon.

Bony tissue being thus removed, accommodation is made for the advancement of the tooth which at once takes place. Under continued pressure this action is renewed again and again until the tooth has reached its intended position. While this is taking place on the advancing side, quite an opposite condition prevails on the side from which advancement has taken place. There the fibrous tissue of the pericementum has been subjected to extreme tension, greater room has been provided for the accommodation of the nutrient vessels, and osteoblasts have been developed for the formation of bony material to add to the alveolar wall and thus close the space caused by the movement of the tooth. While these processes of resorption and reproduction on opposite sides of the tooth have been going on coincidently, their results have been very unequal, for the resorption of bone is a far more rapid process than its formation.

During the entire time of moving, and for a long time afterward, the tension of the pericementum on the free side of the tooth and the resiliency of the bent alveolar plate on

the advancing side are kept up to such an extent, that were the pressure or means of retention removed, the tooth would quickly be forced back into the space created by its movement.

The tendency on the part of the tooth to return to its original position is only finally overcome after the deposit of osseous matter in the alveolar socket is sufficiently great and dense to resist the opposing forces.

While this process of reparative construction has been going on the tissues about the opposite side of the tooth have been adjusting themselves to the new condition. The pressure upon the tooth having ceased no more bone is resorbed or bent; any injury inflicted upon the pericementum by its long compression is repaired; the nerves and blood-vessels resume their normal functions, and the tooth in its new position becomes a far more useful member of the dental organism than it had been.

When a number of adjacent teeth are moved outward in the anterior expansion of the arch, the principal change that occurs in the alveolar process is a distinct bending or yielding of the entire outer plate. This is evidenced by the rapidity with which the movement takes place, and also by the fact that after the movement is completed the process is not perceptibly thinner on the advancing side or thicker on the retreating side of the teeth than it was before the change took place. This flexibility of the process is due to its incomplete calcification at the period of life when operations for irregularity are usually undertaken. That the one alveolar plate should yield to pressure is more readily comprehended than that the opposite one should follow, but the uniting septa being strong and elastic draw the one plate after the other as the movement takes place.

In lateral expansion of the arch, especially in the molar region, it is more than probable that the space is gained by the opening of the median suture which can readily occur early in life. Frequently the arch is widened a quarter of

an inch or more with little effort, and this could scarcely be accomplished by the bending or resorption of the thick outer cortical layer of the process in this region. A separation at the rear of the hard palate would not likely be attended by separation anteriorly and, therefore, no ill-results would follow.

The readiness with which the alveolar process yields to pressure early in life is an important aid in the movement of teeth in that it assists in hastening and simplifying the operation, but advantage should not be taken of it to move teeth too rapily for fear of endangering the vitality of the pulp.

In *extrusion* (forcing a tooth partly out of its socket) the fibres of the pericementum are stretched, but the alveolar walls do not undergo any material change, while the space created about the apex of the root and somewhat along its sides, is soon filled with new alveolar tissue. The stretching of the nerve and blood-vessels that enter the apical foramen will not be injured if the movement is conducted slowly.

In *intrusion* (forcing a tooth farther into its socket) resorption of alveolar tissue about the root takes place as in other cases, and the nutrient vessels are more or less compressed, but they adjust themselves to the condition without any ill-results.

CHAPTER VIII.

DYNAMICS OF TOOTH MOVEMENT.

The use of force in overcoming resistance and causing malposed teeth to assume their proper positions falls within the domain of that branch of Physics known as Dynamics.

The movement of teeth, like the movement of other bodies, is regulated and controlled by certain general principles or laws, and a proper understanding of such of them as are of importance to us in our work is necessary in order that the required operations may be performed intelligently and in a scientific manner.

To construct a machine which by its action will accomplish a desired result may be easy, but to devise one which will give us the best result without a waste of energy or an opposing ill-result, requires familiarity with the principles upon which it is to operate and the attendant conditions which may limit or control its action.

Three mechanical factors enter into the problem of tooth-movement.

1. Secure anchorage.
2. Proper application of force.
3. Character of resistance to be overcome.

Secure Anchorage.—One of the three laws governing the application of force as enunciated by Newton is:—*Reaction is always equal and opposite to action.* A screw-jack, for instance, placed under a house to elevate it exerts as much pressure upon the ground as it does upon the building, but as the resistance of the ground or foundation is much greater than that offered by the house, the latter rises when the screw is turned. If the same screw-jack were placed between two piles of equal size implanted in the earth to the

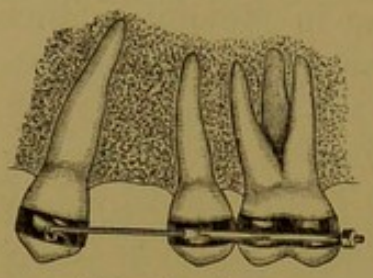
same depth, each would move equally when the screw was turned because one offered no more resistance than the other, action and reaction being always equal. In like manner a screw operating between two similar teeth, as molar and molar or cuspid and cuspid would under similar conditions move one as much as the other. When, therefore, it is desired to move but one of the teeth between which the appliance operates the one used as an anchorage must be much more firmly implanted that the one to be moved. A cuspid would not serve as anchorage in moving another cuspid or a molar for a molar, but either a molar or a cuspid might offer sufficient resistance for the moving of a tooth of less fixedness like an incisor or a bicuspid. Even in such case, however, a single anchor tooth as firmly implanted as a multi-rooted molar or a long-rooted cuspid would be likely to be moved somewhat out of position.

To secure as stable anchorage as possible, therefore, we must (1) combine the resistance of several teeth, or (2) arrange to counterbalance the force exerted upon the anchor tooth or teeth in one direction by another force in the opposite direction, thus making these forces compensatory, or (3) obtain an anchorage or resistance at some point outside of the mouth, as on the top or back of the head.

In any proposed movement of a single tooth either forward or backward in the line of the arch, it has long been customary to select as an anchor tooth one having others adjoining it on the side of the desired resistance. However, even when several teeth thus aid in offering resistance to the force applied, all of them will often yield somewhat to the pressure and become inclined from their vertical positions, because each one has an independent movement and frequently the main anchor tooth will be slightly elevated from its socket. Many cases of attempted regulating in this way have resulted in failure, because after the teeth used for resistance have moved and become loose they can no longer be used as anchorage.

The more recent method of joining together two or more teeth by means of united metallic bands does away with the former difficulty, for by this plan no tooth can move independently of the others nor can any of them be tipped from their vertical positions. Either all of the teeth included in the anchorage will be dragged through the alveolar process in their upright positions, or by their united resistance they will be able successfully to oppose the force applied to them. The latter will naturally be the result. The principle involved is well shown in Fig. 11, where a molar and bicuspid, joined by soldered bands, offer resistance to force applied in the moving of a cuspid tooth.

FIG. 11.



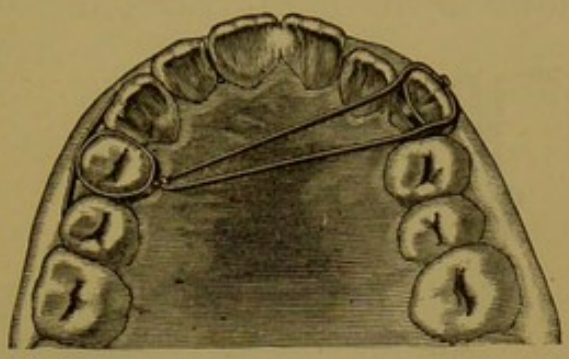
Secure Anchorage.

Resistance somewhat analogous to this is obtained by swaging metal caps to cover the occlusal surfaces of the anchor teeth, soldering them together and cementing them in position. Another method is to have a plate covering the palate and extending laterally so as to include and cover several anchor teeth on each side. So, also, the wire-crib appliance is used to obtain the combined resistance of several teeth in the moving of others. All of these methods are valuable and oftentimes one is more available than any other, but none of them furnish the same firm resistance as is secured by the united bands. A vulcanite plate covering the roof of the mouth is very frequently employed as a means of resistance to applied power, because by its impingement upon many teeth the resistance is distributed over a large area and is not great at any one point. It is, perhaps, the least valuable of all devices for offering resistance because of its liability to displacement, yet it may be employed advantageously in certain cases.

When it is desired to move a tooth either outward or inward into the line of the arch, the resistance to the

applied power will usually have to be secured at a point on the opposite side of the arch, and as in other cases be obtained by combining the resistance of several teeth. Fig. 12 shows how by the use of a single band with a bar attached extending to and touching the two adjoining teeth, the resistance of three teeth is offered to the moving of a cuspid on the opposite side of the arch.

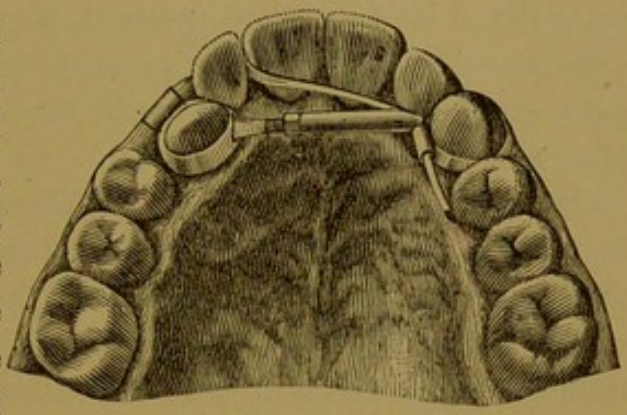
FIG. 12.



Anchorage with single Band and Bar.

Another illustration of the same principle, differently applied, will be noticed in Fig. 13, where by the use of a single band and wire extension, five teeth are made to offer resistance in the moving of an opposite cuspid.

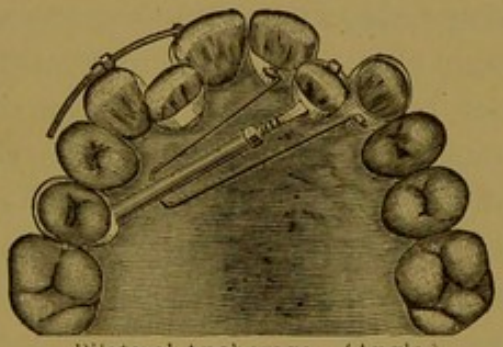
FIG. 13.



Re-enforced Anchorage. (Angle.)

Fig. 14 shows an ingenious combination (devised by Angle) in which teeth on both sides of the arch are made to contribute the necessary resistance for the moving of an inlocked lateral.

FIG. 14.

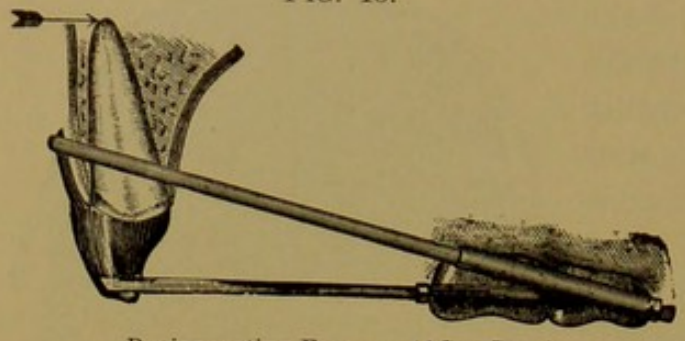


Bilateral Anchorage. (Angle.)

The second method of securing stationary anchorage, that of opposing a force in one direction by another in the opposite direction, is an extremely valuable one where the conditions are favorable for its employment. A tooth thus used for anchorage will remain stationary provided

both forces are equal. An illustration of this principle is given in Fig. 15, where it is desired to move the crown of a tooth in one direction and the root in an opposite one.

Fig. 15.



Reciprocating Forces. (After Case.)

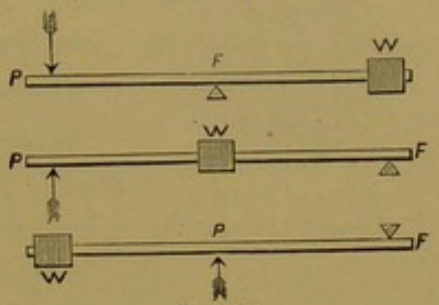
The third plan of obtaining anchorage, namely, that of using the dome of the head, is, in the nature of the case, limited in its applicability, but where it can be utilized it is an ideal method, for it affords an amount of resistance far beyond any possible needs. Practical applications of the principle will be noticed in succeeding chapters.

Proper Application of Force.—When power is to be applied for the movement of a tooth, attachment for the purpose must be made to some portion of the crown, as that is the only part available. Resistance to such movement is furnished by the alveolus, and especially, when the movement is in a labial or lingual direction, by the harder cortical layer covering the alveolar plates. If all of the bony tissue comprising the socket were of equal density, the pivotal point of such movement would be very near the apex of the root, because there the tissue is greatest in quantity. As, however, the alveolar tissue about the root and especia ly towards the apex is open and spongy, and the cervical portion of the root is almost in contact with the dense cortex, it follows that the pivotal part of the tooth must be nearer this surface.

As, therefore, in the ordinary movement of a tooth we have a resistance to be overcome, a force exerted to overcome such resistance and a fulcrum or point of relative immobility, it is evident that the tooth in its movement becomes a lever.

A lever is described as "any rigid bar, straight or bent, resting on a fixed point or edge, called a fulcrum." The forces acting on the lever are the weight or resistance (W), the power (P), and the reaction of the fulcrum (F). Levers are divided into three classes. In the first class the fulcrum (F) is situated between the power (P) and the weight (W), as in a crow-bar or a child's see-saw. In the second class the weight (W) is between the power (P) and the fulcrum (F), as in a wheelbarrow or a door. In the third class the power (P) is between the fulcrum (F) and the weight (W) as in a pair of tweezers or the human forearm. The three forms of the lever are shown in Fig. 16.

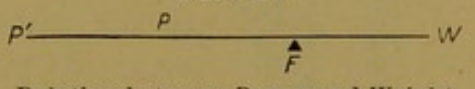
FIG. 16.



Levers.

In the ordinary movement of a tooth, the principle involved is that of a lever of the first class, the distance from P to F representing the crown, that from F to W the root, and F the cortical layer of the alveolus. If, by any means, we can lessen the distance between F and W or increase that from F to P we will gain a corresponding advantage, for on the principle of the lever (when there is equilibrium) "The power arm is to the weight arm as the weight is to the power." In diagram Fig. 17, if we desire to raise a weight of 20 lbs. at W we can do so by applying a downward force of 20 lbs. at P, since P and W are equidistant from F., but if we apply our power at P′ a force of 10 lbs. will accomplish the same result because the distance from P′ to F is twice as great as the distance from W to F. Expressing it in a formula, we have P′F : WF :: W : P′ or 2 : 1 :: 20 : 10.

FIG. 17.

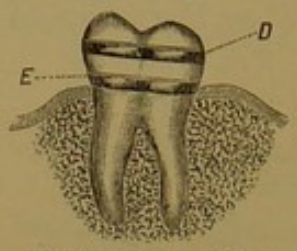


Relation between Power and Weight.

Therefore, in any attempt to move the crown of a tooth, force should be applied as near the occlusal surface as possible. Conversely when we desire to use a tooth for anchor-

age, our attachment should be made as near the cervical margin as possible for we thus shorten the distance between the power and the fulcrum and correspondingly lessen the liability of moving the tooth.

Fig. 18.



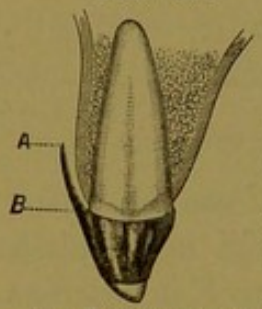
Position of Band for Anchorage Attachment.

In Fig. 18, an attachment for anchorage made to the band E will for the reason just given, accomplish its object far better than if made to a band in the position of D.

When we desire to move the root of a tooth without moving the occlusal portion of the crown, we must do so on the principle of a lever of the third class. The fulcrum F must be close to the occlusal surface and the power P applied as near to the cervical margin as possible in order that the resistance W may be overcome with the least expenditure of force.* To secure a fulcrum at the occlusal surface, it is necessary to have a band attached to the crown at this point and by some means connect this band with the anchorage.

Prof. C. S. Case was the first to show that in a movement of this or any similar kind great advantage is gained by applying the power at some point opposite the root instead of upon the crown. His method of doing this is to solder a short rigid bar to the band surrounding the tooth to be moved and to have this bar extend outside of the gum in the direction of the root as far as the lip or other tissues will permit, as shown in Fig. 19. By this plan the force is applied nearer to the end of the root and farther from the cervical margin (fulcrum) thus greatly increasing the leverage. How force applied at the free end A of the bar can operate to greater advantage in moving the root than if applied at the point B of the band where

Fig. 19.



Bar Extension for Increased Leverage.

*It should be borne in mind that in all cases W represents the resistance to be overcome and that with a tooth the root or roots are simply one arm of a lever. The actual resistance is the alveolar tissue surrounding the root.

the bar is attached, may be best understood by reference to the diagram. Fig. 20.

Let A D represent a lever with a fulcrum at F. To this is firmly attached another rigid rod, B C. It is evident that any force applied to the arm F D in one direction will cause the other arm, A F, to move in the opposite direction on the principle of a lever of the first class; but since the two rods, B D and B C, are rigidly united, they must act in unison so that a force exerted at any point along f C will cause the arm F D to move in the same direction and A F to move in the opposite one. Thus we see that the motion of F A is the same whether we apply the power along f C or along F D, and conversely, power applied in one direction at any point of the arm F A will cause both f C and F D to move in the opposite direction. On the same principle any force applied at C in the direction E C will be correspondingly felt along the line F D. Whether the bar B C be straight, curved or angular will make no difference provided it be rigid. Applying these principles to the moving of a tooth in its socket it will be apparent that any force applied above the alveolar border as at C (Fig. 21), will tend to move the root F D in the same direction whether it be labially or lingually, for it is equivalent to applying the force to the root itself.

Fig. 20.

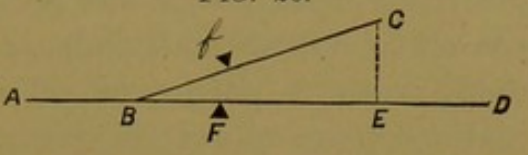
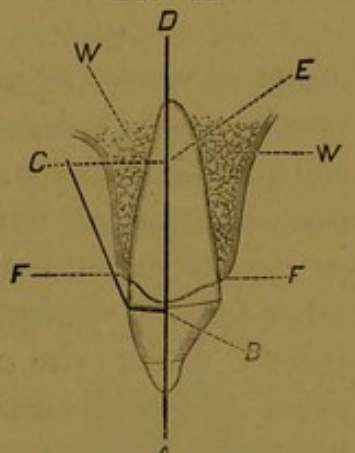


Fig. 21.



Principle of Increased Leverage.

Of the different mechanical powers several are employed to a greater or less extent in the regulation of teeth, although the greatest efficiency is obtained from the screw.

The Lever.—The principle of the lever is not often embodied in a regulating appliance, both on account of its inapplicability and because other forms of applying force serve us to better advantage.

The Inclined Plane. — This is used only in very rare instances, although where applicable its efficiency is very great. In certain simple forms of malocclusion, an appliance embodying this principle is applied to teeth in one jaw in order to change the position of a tooth in the opposite one. Occasionally, also, a vulcanite or metal plate is made with a portion of it arranged in the form of an inclined plane to aid in changing the bite or occlusion of the teeth in the opposite jaw.

The Wedge. — Pieces of elastic rubber or of compressed wood inserted between the teeth or between an appliance and a tooth are usually spoken of as wedges, but they are not such in reality. The former operates by virtue of its resiliency and the latter by its elasticity—that is, the force is derived from the fibres of the wood resuming the form they possessed before being compressed. Strictly speaking, the principle of the wedge has never been employed in the movement of malposed teeth.

The Screw.—The screw is a combination of the inclined plane and lever. Two inclined planes, one on the screw and one on the nut, play upon each other and are operated by a lever. Its slow movement together with its direct delivery of force and positive action constitute it the best form of mechanical power for use in the mouth when conditions favor its employment. Usually both screw and nut are of metal, but sometimes the metallic screw is made to operate in a threaded hole in a vulcanite plate. In no other form of instrument is the application of force so completely under the control of the operator, and one of its great advantages is that it can be operated by the patient himself. Its wide range of applicability easily places it at the head of devices for the moving of teeth.

Elasticity.—Less valuable than the screw, but probably more valuable than any other method of applying power is elasticity. The force obtained through its agency is less direct and positive than that obtained from the screw, but

it can often be employed to advantage when the latter cannot and hence is most serviceable in applying force to malposed teeth. It is usually employed in the form of a bar, bow or spring of some metal or its alloys, though its power is also utilized through the agency of elastic rubber and vulcanite, wood, silk and linen ligatures and other substances.

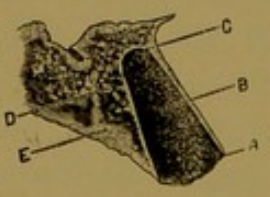
Character of Resistance to be Overcome.—We have already spoken of the general structure of the alveolar process, but in order to obtain a clearer understanding of the character of resistance it offers to the movement of the different teeth, it will be necessary to notice certain peculiarities of this structure at various points of the alveolar arch.

On a careful examination of the superior maxilla, we will notice that in the incisor region the outer plate of the alveolar process is exceedingly thin and conforms so closely to the roots of the teeth as to distinctly outline their form and extent. This thinness of the plate is due to the fact that it is composed almost entirely of the cortex, there being very little cancellate tissue underlying it. Proceeding backward we find this outer plate gradually increasing in thickness to the second and third molars.

With the inner or lingual plate it is different. In the incisor region, while it is attenuated at the alveolar border, it rapidly increases in thickness in the direction of the roots on account of the cortical layer sloping off to form the palate. This is equally true of that portion lying next to the bicuspid and molar teeth.

Fig. 22 represents a section of the superior maxilla adjoining the median line. B is the alveolus or socket of the central incisor. A and C show the relative thickness of the cortex composing the external alveolar plate, with very little cancellate tissue underlying it. E represents the thick cortex of the inner plate, not only near the alveolar border, but in its continuation to

FIG. 22.



Section through Superior Alveolar Process near Median Line.

form the palate, while D indicates the large amount of cancellate tissue at the base and inner portion of the alveolus.

It will thus be seen that owing to the varying character of resistance offered, certain movements of the superior incisor teeth are more readily accomplished than others.

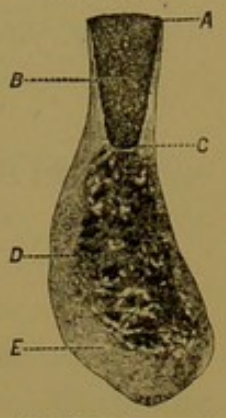
The outward movement of an incisor crown is effected with comparative ease, because the outer alveolar plate being thin and elastic, bends in response to pressure, while the apical end of the root, tending to move in an opposite direction, presses upon the cancellate tissue on its inner surface, which is readily broken down and resorbed.

The inward movement of the same crown is accomplished with somewhat greater difficulty because there is very little yielding of the inner alveolar plate, owing to its mass and solidity. Thus, while the crown moves inwardly and the root outwardly, the cervical portion scarcely changes its position at all.

In nearly all cases of superior protrusion there is a lack of fulness under the upper portion of the lip, and the improvement of facial harmony following the correction of the deformity is due, in great part, to the outward movement of the apical ends of the roots, which must necessarily accompany the inward movement of the crowns. This is equally true, though to a lesser extent, in similar movements of the bicuspids. In the superior molar region both alveolar plates are so thick that it is doubtful whether they bend under pressure to any appreciable extent. The movement of these teeth in an outward direction is probably accomplished only through the slow process of resorption, or by a separation of the two halves of the palate at the median suture. In the lower jaw, there being no palate, the thickness and structure of both the external and internal plates in the incisor region are very similar, which accounts for the equal facility with which an incisor may be moved, either in a labial or lingual direction. Fig. 23 illustrates this condition, the lettering of the parts being similar to that in Fig. 22.

In the molar (and partly in the bicuspid) region of the inferior alveolus, the teeth are even more immovably fixed than in the superior, owing to the greater thickness and prominence of both alveolar plates. Great force applied to move the lower molars outwardly can accomplish its object only by slow resorption.

FIG. 23.



Section through Inferior Maxilla near Median Line.

A marked peculiarity of the cortical layer of both superior and inferior maxillae, is that while it partly encircles the teeth at their cervical margins, it does not appear to cover the free edges of the septa. This accounts for the fact that teeth are much more readily moved either forward or backward in the line of the arch than in a direction at right angles to it. The septa being composed entirely of loose cancellate tissue, its resorption readily takes place. It also explains the tendency of anchor teeth to change their positions in response to pressure exerted in the line of the arch.

PART II.

CHAPTER I.

MATERIALS AND METHODS.

EXAMINATION OF THE MOUTH.

When a case of irregularity presents for treatment, the first requirement is a careful examination of the mouth and teeth.

In conducting this examination it is necessary to note the position of the teeth, their relation to one another, their occlusion with those of the opposite jaw, the relative size and shape of both arches, the size, character and condition of the teeth, the age and general health of the patient, the harmony or inharmony of the features and the facial expression.

A careful consideration of all these points will enable us to decide:—

1st. What is desirable.

2nd. Whether it can be done.

3rd. If possible, how it can best be accomplished.

After this preliminary examination, our opinion of the case should be given the patient or parent accompanied by a plain statement of the difficulties of the case, if such exist, the probable time that will be required for correction, and an approximate estimate of the cost. To avoid any possible misapprehension the patient should also be informed that the appliances will cause some annoyance and possibly some pain, and that patience, endurance and perseverance will be necessary on his or her part to enable us to accomplish a satisfactory result.

It should also be mutually understood that the parent or patient shall assist in the furtherance of the work by seeing that the appliances are faithfully worn, that all the instructions are carried out, and that the patient shall punctually meet all appointments that may be made.

Should the prognosis of the case prove satisfactory and all of the above conditions be agreed to, we may at once proceed with the treatment.

Impression and Articulation.—The first step will be to take impressions of the upper and lower teeth from which to secure models for the further and more exact study of the case.

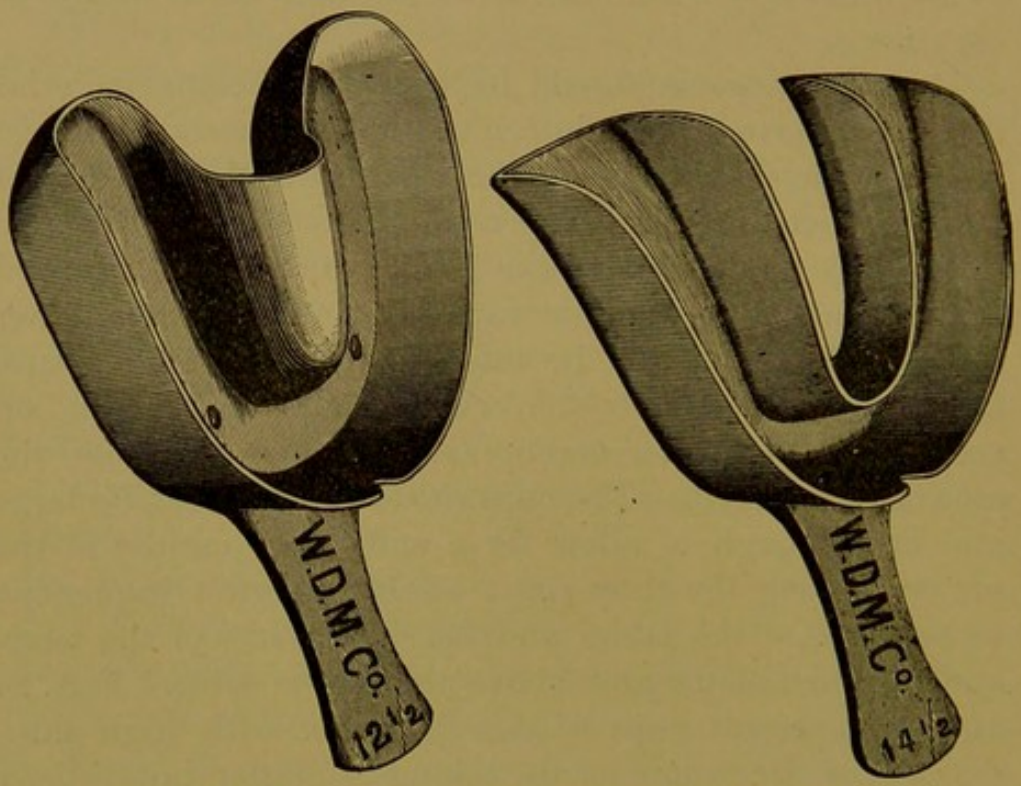
These impressions should be taken with some material that will receive a sharp imprint and not materially change its shape in removal from the mouth. Either Plaster of Paris or Modelling Composition (Stent's or Godiva) will give satisfactory results, but as the former can only be removed from the mouth by being broken into many pieces the latter is generally preferred. In selecting the impression cups, those known as flat-bottom cups should be chosen, on account of the better accommodation they afford for the crowns of the teeth. The cups should in all cases be large and deep enough to allow for a sufficient quantity of the material along the outer rim to enable a perfect impression to be taken of the labial and buccal surfaces of the teeth, and as much of the gum above them as possible. Figs. 24 and 25 represent cups of this character with high sides, devised by Dr. Angle for the taking of plaster impressions, but they answer quite as well for Modelling Compound.

A proper quantity of the composition having been softened by dry heat or in hot water, it is placed and properly shaped in the previously warmed cup and rapidly introduced into the mouth.

In taking an impression of the upper jaw the mouth should be kept well open so that the teeth may not come in contact with the material before the proper time and thus

mar the surface. When the cup with its contents has been placed as far back as necessary, and immediately beneath the teeth, it should be brought up into position with a straight and steady movement. Once there, it should be firmly held while a finger is introduced to force forward into position the portion of material that has escaped at the rear of the cup, after which all that portion along the outer rim should be pressed against the teeth and gums from molar to molar.

In this position it must be held until it has become so



FIGS. 24 and 25.—Angle's Impression Cups for Irregularities.

hard that a finger nail will scarcely indent it, when it should be carefully removed. The hardening is best hastened by a stream of cold water from a syringe, or by the renewed application to the cup of small sponges or napkins dipped in ice water as suggested by Prof. Newkirk.

In taking an impression of the lower jaw the same general method is followed, and after the cup is in position all the

surplus material around both the outer and inner rims should be pressed into place with the finger.

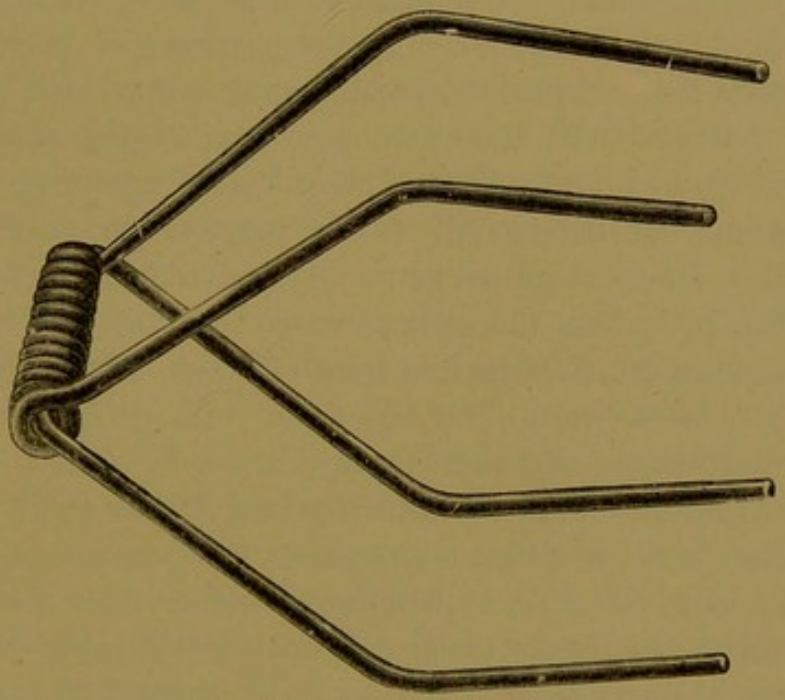
The models obtained from impressions taken in this manner will be sufficiently accurate to give us a good representation of both the buccal and lingual surfaces of the teeth, so necessary to a proper study of the case.

Impressions taken in plaster are the most accurate in detail, but the compound gives us all the accuracy we need in models for regulating.

During the same sitting at which the impressions are taken, the manner in which the teeth occlude should be observed and recorded, so as to enable us to place the models in proper relation while being attached to the articulator. This will dispense with the necessity for taking a bite.

An inexpensive and excellent articulator, Fig. 26, for the mounting of models of irregularity, is made from brass wire. The upper arms and coil are one continuous piece, while the lower arms are formed by passing another piece of the wire through the coil and bending to shape.

FIG. 26.



The Author's Wire Articulator.

The articulator is so slender in outline that after the models are attached to it the occlusion of the inner cusps of the teeth may be as readily examined as that of the outer ones.

With the models properly mounted on the articulator, our second and more deliberate study of the case may be carried forward at our leisure.

At the first or personal examination of the case, we are supposed to have decided upon the advisability of an attempt at correction, and also upon the general plan we purpose pursuing. By the study of the articulated models we will be enabled to decide upon the details of the work and the kind of appliance that should be used. Both studies are necessary, for with the patient in the chair we cannot take the time to map out the proposed work in detail, while an examination of the models alone will leave us without a knowledge of many important characteristics of the case that can only be gained from a personal examination.

Articulated models, made and mounted as described, are most important not only for purposes of present study, but also for comparison as the work progresses. Inasmuch as they represent the exact condition of the case at the beginning, we have in them a means of ascertaining what advancement has been made at any stage of the operation, whether the different movements are proceeding satisfactorily, and finally, when the operation is completed, of observing just how much change has been effected. An ocular comparison is of some value, but one made with calipers and rule is far more exact and satisfactory.

Study of Case From Articulated Models.—The study of the case may be either a simple or difficult one, according to the conditions and requirements involved. Thus, the movement of a single tooth will only involve the consideration of providing accommodation for it in the arch and the manner of applying force to bring it into position, whereas when a number of teeth in different locations are to be moved, each perhaps requiring a different form of movement, we will have to decide whether we can and should produce all of these movements with one appliance at one time, or whether

it would be best to produce each movement separately and possibly with different appliances. If the latter, we will have to determine which should be accomplished first, which next, and so on.

For instance, where the entire upper arch is to be expanded to make room for outstanding cuspids, we will have three different operations to perform; the side teeth must be moved laterally, the anterior ones forward and the cuspids inward into line. To produce all of these movements at the same time with one appliance would be impossible from the nature of the case, therefore they will have to be performed separately, and usually in the order in which they have been named. In attempting to produce many movements with one appliance we often defeat our object, although occasionally, where the movements to be produced are of opposite character, we may advantageously play one against the other.

Where they are of the same character, or nearly so, too much should not be attempted at one time, for the loosening of many teeth will be liable to make our anchorage unstable, in which case we would have to suspend all operations until some of the teeth again became firm.

Having decided upon the order in which the movements should take place, we have two other important points to determine.

Amount of Power Required.—This will be determined largely by the age of the patient and the character of the teeth and process. As previously stated, early in life, before the process has become fully calcified, the teeth can be moved more rapidly than at a later period, and less power will be required to accomplish it; so also, in patients of the same age, the teeth of one will be more readily moved than those of the other. This is due both to the relative length of the roots and the resistance of the alveolar walls with their dense cortical covering, and as we cannot judge of either with any degree of exactness, we have to form our opinion in the matter from the general conditions.

Observation has shown that teeth with large crowns, situated in large and firm-looking jaws, usually have long roots; whereas, smaller teeth, associated with thin and more delicate processes, have shorter roots.

Therefore, considering the age of the patient and the appearance of the teeth and processes, we can at least decide whether the amount of force to be applied should be great or little.

Manner of Applying Power.—Among the many appliances or substances for yielding power in the moving of teeth, the practitioner has a range of choice from the screw with its directness and power, to the silk ligature with its gentle traction.

Between these two extremes we have materials that will yield us force in any desired degree. Selecting the one which seems best suited to the case, we must next decide upon the most advantageous manner of using or applying it.

There are two general methods of securing the power-producing appliances in the mouth. One is the use of a plate of some kind to which attachments can be made, and the other is the plan of attaching the appliances to the natural teeth in such a way as to dispense with the wearing of a plate.

In certain methods of regulating, such as Angle's, Jackson's and Patrick's, no plate is used; while in others, such as Coffin's, a plate is invariably used for attachment and security. Farrar advocates the use of a plate only in exceptional cases. Each manner has its advantages and disadvantages. In the use of a plate, we have as advantages:—

Its Convenience and Adaptability.—Covering a large surface, it affords opportunity for the attachment of the immediate power-yielding appliance in any position and at any angle, and permits the same to be altered or changed with very little trouble. It also protects the soft tissues from any possible injury which might result from the slipping or impingement of other appliances upon them. Indeed, in

many cases, a plain rubber or metal plate covering the roof of the mouth and not having any appliances attached to it, is used simply for the protection of the gums during the operation of regulating.

Its Distribution of the Power of Resistance.—Touching all or nearly all of the teeth not being operated upon, it compels each one to bear its part in offering resistance to the power applied for the movement of certain teeth, and in this way brings more teeth into use as points of resistance than could possibly be done by any other method.

Its simplicity of construction and the facility it affords for adjustment and alteration.

The disadvantages pertaining to the employment of a plate as an aid in regulating, are :—

Its Uncleanliness.—Inasmuch as a plate comes in contact with so much tooth surface at the necks and elsewhere, it offers special opportunity for the accumulation of debris. In plates that are removable by the patient, this may be largely avoided by frequent cleansing, but observation has shown that the majority of patients are either so careless or indifferent in regard to the matter, that a clean regulating plate is seldom seen. In plates so constructed or arranged that only the dentist can remove them, the uncleanliness of the plate and consequent danger of injury to the teeth is greatly increased.

The Frequent Appointments Necessary.—In the class of plates last alluded to, it is absolutely important that they be removed and cleansed at least once in every forty-eight hours. This requires such frequent visits on the part of the patient and the expenditure of so much valuable time on the part of the operator, as to constitute a serious objection to the use of plates where they can at all be dispensed with.

When plates are not used, appliances are usually attached directly to certain teeth which serve as anchorages. Such attachment is generally secured by means of bands or collars encircling the teeth and cemented to them; or, in other

cases, by having the bands simply passed around the teeth of attachment and drawn tight by means of screws or clamps.

When bands are placed around teeth and secured by some mechanical device, they never can fit the teeth so accurately as to avoid spaces for the accumulation of food and saliva. The fermentation of the particles of food, and the acidity of the saliva in a state of rest, will soon injuriously affect even good tooth structure.

This can only be prevented by the employment of some material that will perfectly fill the space between the band and the tooth, therefore all bands passing around and encircling the teeth, in order to be harmless, should be cemented in place with phosphate of zinc.

The advantages of appliances attached to the teeth in this way are:—

1st. The leaving of the roof of the mouth uncovered, thus affording more room for the movements of the tongue.

2nd. Their greater cleanliness, because they touch the teeth at few points, and thus furnish good opportunity for thorough cleansing with the brush.

3rd. Not needing to be removed, fewer visits to the dentist are necessary, thus effecting a great saving in time and labor.

and a dozen other advantages

CHAPTER II.

APPLIANCES.

MATERIALS AND THEIR USES.

During the study of the case, after we have decided upon the amount and kind of power we wish to apply in order to produce the desired movements, it will be necessary to consider the different materials at our disposal in order that we may select from them the ones best suited to our purpose for the case in hand.

Platinum and Its Alloys.—Platinum, on account of its tastelessness, its non-oxidability and its harmonious color, should constitute it one of the best metals for use in the mouth. Its extreme pliability and softness, however, greatly limit its usefulness, so that it can be used only where these latter qualities do not interfere with its employment.

It is chiefly used in the construction of bands that are to be cemented to the teeth to serve as anchorages for appliances or to form parts of retaining fixtures.

In combination with other metals, in the form of alloys, its greatest usefulness is developed.

Iridio-Platinum.—This alloy, combining the color and purity of platinum with the hardness and stiffness of iridium, is useful for bands, bars and wires in connection with regulating appliances where platinum alone would not be available on account of its softness.

It can be hard-soldered without losing its elasticity.

Platinous Gold.—Gold in a pure state, or alloyed with silver or copper, does not possess the stiffness necessary for its use in the form of bars, springs or accessories, where great resistance or elasticity is requisite, but when alloyed with about five per cent. of platinum it attains a degree of

elasticity second only to steel. In this form it is one of our most useful materials, for even the heat of soldering does not rob it of its elastic quality.

This alloy of gold can be purchased in the dental depots in plate of any thickness and in wire of any form or size. When used for the construction of screws or supports, its stiffness is the property taken advantage of, while in the form of levers or bows its elasticity constitutes its chief excellence.

Platinous Silver.—This alloy, though long and favorably known in England, has never been extensively used in America. It is prepared for the market in the form of plate and wire of every gauge. In the form of plate it is largely used abroad as a base for artificial dentures, especially small partial pieces, while the wire is used as a support for the Ash tube-teeth and other purposes.

The alloy is composed of one part of platinum to two of silver. Its stiffness and elasticity is but little inferior to platinous gold, while its cost is about one-half that of gold. It can be rolled, bent or fashioned to any form and may be soldered with the highest grades of gold solder.

In the form of wire the author has found it very useful in the construction of bows for the attachment of rubber bands or ligatures to draw teeth in any direction, and for parts of retaining appliances where inconspicuousness is desirable.

Its non-oxidability is also a feature of considerable value.

Platinoid.—A new alloy, under this name, has recently been brought out as a substitute for other platinous alloys. In its properties it greatly resembles iridio-platinum. It probably contains no platinum, but it is inexpensive, almost non-oxidable and very elastic. It comes in all thicknesses of plate and all forms of wire.

German Silver.—This improperly named alloy, composed of copper, zinc and nickel, is frequently employed in the construction of regulating appliances, on account of its stiffness and inexpensiveness. While it may be regarded as a base compound, its baseness is of so high a grade that it

may be used without fear of harm to the soft tissues or the general system. Prof's. Angle, Matteson and Jackson use it very largely in the construction of their appliances, and the author has made frequent use of it without ever noticing any deleterious effects. Hard-drawn wire of this alloy serves admirably for bows or bars, and soft-soldering does not destroy its temper. Its valuable qualities are many, and the ease with which it may be electro-gilded furnishes us with a means of improving its appearance.

Gold.—Gold, in its non-elastic condition, has been and probably always will be one of the most useful of the metals for the construction of parts of regulating appliances. Its softness, adaptability and strength are all qualities of the greatest value and render it serviceable in numberless ways. To preserve its purity, and as far as possible to prevent oxidation, it should never be used of a carat less than 20 or 22.

Steel.—This metal has the same desirable qualities of firmness and elasticity that are found in platinous gold, and possesses them in a higher degree, so that it is used in preference to the former metal where greater power is needed.

There are two disadvantages, however, connected with its use:—one is, that it cannot be highly heated (as in soldering) without destroying its temper; and the other, that it oxidizes so readily when in contact with the fluids of the mouth. This latter objection is largely overcome by electro-plating it with gold, a full description of which method will be found in the latter part of this volume. It is used principally in the construction of jack-, and other screws and as wire in the form of bows, levers and springs.

Vulcanite.—Soon after the introduction of vulcanite as a base for artificial teeth, its qualities of adaptability, strength and elasticity were recognized and utilized in the construction of appliances for regulating. By its use we secure advantages that could not so readily be gained from other substances.

Used either to produce pressure by its own elasticity, or as a medium for the attachment of other power-producing appliances, it has been one of the most commonly employed materials for the construction of regulating appliances.

Compressed Wood.—The use of this substance is very old. Before the introduction of either soft or vulcanized rubber, the expansibility of compressed wood under moisture was employed in lieu of elasticity.

It was used chiefly in the form of small sections placed between a silver or gold plate and the teeth to be moved, a suitable slot or socket having been formed in the plate for its retention.

In this way it is no longer used, other materials possessing superior qualities having superceded it.

The author occasionally finds great advantage from its use in the separation of teeth for the accommodation of some malposed tooth, where the existing space, though not sufficient, is still too great to admit of the use of elastic rubber.

In such cases it is his custom to cut a cross-section from some compressible wood, such as cotton-wood, a little larger than the space it is to occupy. This is compressed in the direction of the length of the fibre by means of a hammer, after which it is notched at each end to fit the convex surfaces of the teeth to be moved. Upon being placed in position its expansion by the absorption of the fluids of the mouth quickly causes movement of the teeth. In the course of its expansion it adapts itself accurately to the tooth surfaces and thus does not become dislodged or slip from its position.

Sea-Tangle.—This is one of the newer substances introduced into the list of materials that are of service in regulating. The idea of its use was borrowed from the medical fraternity, who first employed it for dilatation of the cervix uteri. It is a variety of sea-weed botanically known as *laminaria*, that has been robbed of its moisture and compressed until its density is about equal to horn. For medical use it comes in the form of a cylindrical tent about one-fourth of an inch in thickness and two inches in length.

This is the only form in which it has been placed upon the market. In the presence of moisture it rapidly expands from two to three diameters. As it expands only in the direction of its width, sections from it must be so cut and shaped as to take advantage of this lateral enlargement.

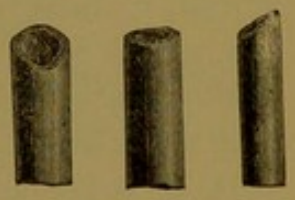
In regulating it may be employed in place of compressed wood, and like it is used to produce pressure between the unyielding plate and the tooth to be moved. A place for it is readily provided by cutting a hole or socket in the rubber plate at the desired point.

Its advantage over rubber or wood lies in its greater expansive properties and the ease with which it can be secured in place. A piece of suitable size may be placed in position and the plate properly secured in the mouth before expansion begins.

Elastic Rubber.—The resilience of elastic rubber was early recognized as a valuable property that might be used to advantage in producing traction upon teeth to be moved. It was first used in the form of strips attached at either end by ligature, but since the introduction of rubber tubing, rings or bands cut from the same have been employed instead. Their first employment has been credited to Dr. E. G. Tucker, of Boston, about the year 1846.

These sections, cut from the smaller sizes of French rubber tubing, are now in almost universal use in connection with other appliances for regulating, and their value has been greatly enhanced since the Magill band has furnished a better means for their attachment.

FIG. 27.



Sizes of Rubber Tubing most generally used.

Their power, though great, is limited, for they cannot exert so great a force as the metals, but their wide range of applicability and the persistence of their power places them among the most valuable adjuncts of regulating devices.

In use, their tendency to slip off the tooth or up under the gum (which constitutes the chief objection to their employment) must be guarded against by so securing them that change of position will be impossible. They should never be permitted to rest upon or touch the soft tissues at any point.

Silk Ligatures.—The contraction of silk, linen or cotton thread in contact with moisture, enables us to make use of it where the gentlest tractile power is desired. Most frequently it is employed simply as a ligature in attaching some appliance to the teeth, but it has often been used to advantage in cases where teeth were to be moved slowly and a very short distance. Prof. Peirce employs it in this way for the moving of certain single-rooted teeth. Its gentle power, together with its safety and simplicity, will often prove the very qualities we desire in certain simple operations.

Linen Floss.—This material is almost as serviceable as silk-floss and much less expensive. Besides being very strong it contracts greatly when moistened, and is not liable to change its position, especially if well waxed.

China-Grass Line.—This material has been extensively used in New England for ligatures in regulating, being preferred for that purpose to silk, cotton or linen.

It is the *Boehmeria nivea* of botanists, and more commonly known as Ramie or Rhea fibre, and is the material from which China-grass cloths are manufactured. It is stiff enough to be threaded with a pair of tweezers between the teeth at their necks, thus avoiding the pain of forcing a ligature between them when tender.

It is non-elastic, but shrinks greatly without softening when moist, thus exerting considerable traction without producing pain. It comes in the form of fish-lines.

QUALITIES AN APPLIANCE SHOULD POSSESS.

In selecting a form of appliance from among the many that have been devised by writers and workers in this field of practice, or in devising one to suit the demands of the case under consideration, it will be well to consider and bear in mind the qualities any appliance should possess in order to render it most effective.

The following are among the most important of such qualities :—

Efficiency.—The first requirement of any device is, that it shall be able to do the work expected of it. All appliances are, of course, devised with this end in view, but the attainment of it is often not as simple a matter as might at first appear. Almost every case has associated with it so many features and peculiarities claiming consideration, that even with the greatest care and thought we often fail to apprehend or grasp each individual complication. Some, indeed, are so little apparent that they can scarcely be recognized in advance.

For this reason even the most experienced practitioners will at times devise an appliance which, though seemingly meeting all the requirements, will, when brought to a practical test, fail to accomplish the end desired. It will then have to be altered or perhaps discarded in favor of some other fixture more perfectly adapted to the requirements of the case.

An appliance that will not yield the results we desire, or which yields them in an imperfect manner, should in all cases be superseded by another.

Simplicity.—A complicated device is in nearly all cases less efficient than a simple one. Simplicity is a cardinal virtue in all matters of construction, and through lack of it about seventy-five per cent. of the patents granted in this country prove unprofitable.

Far greater mechanical ingenuity is displayed in an effective simple device than in a complicated one.

Rapidity of Action.—In order to lessen the discomfort of the patient and to conserve the time of both patient and operator, a regulating appliance should be as rapid in its action as is consistent with physiological conditions. Too rapid action may cause suffering to the patient and possibly bring about deleterious results, while too slow action will prolong the treatment unnecessarily and possibly cause the patient to become disheartened and abandon the treatment.

Between these two extremes there is a mean in which the best results are accomplished.

All regulating appliances are at best a source of some discomfort to the patient. A foreign body in the mouth, occupying a certain amount of space and thereby interfering more or less with natural functions, cannot fail to be objectionable. In order, therefore, to lessen his discomfort as much as possible, we should try to devise appliances that will occupy no more space than is necessary and also have them free from all rough projections. Very little is required to cause abrasion of or injury to the soft tissues of the oral cavity, and when once caused such lesions are the source of much pain.

Least Interference with Speech and Mastication.—Most patients apply to us for correction of irregularity at a time when their education is in progress. Their lessons must be recited, and their enunciation must be distinct enough to be understood by the teacher. With a large and cumbersome appliance in the mouth it would prove very difficult for them to speak distinctly, and they would thus be placed at a disadvantage.

They are also in their growing age when the body needs an abundance of nutritious food to supply the demands of the various tissues. If mastication be insufficient through imperfect occlusion or through tenderness of the teeth caused by a bulky fixture, nutrition will be inadequate to the needs of the system.

Such conditions can and ought to be avoided by a properly constructed appliance.

Cleanliness.—The cleanliness of any appliance will depend both upon the method of its construction and the care that is taken of it. If it be removable so that the patient can take it out, cleanse and reinsert it, there ought to be no difficulty about its being kept clean. The patient should be instructed to remove it for cleansing at night, in the morning, and after each meal, at the same time giving the natural teeth a thorough brushing.

A good plan is to supply the patient with a brush, properly marked, to be kept in the office. When the patient appears and the appliance is removed, the operator should see that both plate and teeth are well cleansed in his presence. This one cleansing he will be sure of, though he may not be certain of the others. The same plan is pursued with plates or appliances that can only be removed by the operator. Where appliances are of such character that they seldom need to be disturbed, the patient should be taught to take a quantity of water in the mouth, and then using the lips and cheeks bellows-fashion, force the water through every interstice of the teeth and appliance to flush out accumulations. This should be done each time after eating as well as before retiring and after rising.

Most appliances can be worn a long time without injury to tooth substance, if they are properly constructed and kept scrupulously clean.

Without cleanliness, the teeth will soon be injured by the secretions and accumulations, and the breath of the patient, from the same cause, will become so offensive as to disgust all brought within its range.

Inconspicuousness.—Annoyance from wearing a conspicuous appliance is often added to the other ills which the patient is subjected to during the process of regulation. An appliance of this character, while often producing distortion of the lips, also attracts much attention and compels the wearer to make frequent answers to the same oft-repeated question.

Young persons attending school or entering society are

naturally very sensitive to the ill-appearance of any conspicuous device. Whenever the same result can be accomplished by a concealed fixture as by an exposed one, it is better to adopt the former; but where a better or more satisfactory result can be obtained by the use of a more prominent fixture, appearance will have to be subordinated to utility.

Stability.—The quality of stability has previously been spoken of, but its real practical importance cannot be too strongly insisted upon. It is a *sine qua non* in orthodontic practice. With it, we have a reasonable certainty of results; without it, all is uncertainty.

In some cases, as where most or all of the superior teeth are to be drawn backward, we have apparently no point for proper anchorage. Stability or fixedness of position for an appliance, in such cases, not being obtainable within the mouth, some fixture can be devised which will have its point of resistance outside, as on the back of the head.

This plan of securing resistance outside of the mouth, has been adopted thus far only in a few exceptional cases, but it is hoped that its advantage and importance will lead to its more frequent employment in the future.

Freedom from Injury to Tooth Substance.—By this we do not mean chemical injury, for that has already been treated of, but we refer to mechanical injury. Any sharp, hard point or roughness of a metallic appliance, will be likely to scratch and mar the surface of enamel and thus prepare the way for future decay.

Steel screw-jacks of any form, when placed directly against the teeth of anchorage and those to be moved, are liable to work injury to tooth structure. For this reason there should always be interposed between the teeth and screw some material that is non-injurious to the tooth. Besides protecting the teeth, such substance will also serve to give greater security to the screw.

To obtain this same fixedness for the point of a fish-tail screw-jack, or other appliance, some operators have been

in the habit of drilling a hole or depression in the tooth to be moved. It is hoped that the introduction of the Magill band has caused the abandonment of this practice, which at best was only justifiable in exceptional cases and in self-cleansing localities.

RETAINING APPLIANCES.

The retention *in situ* of teeth that have been moved, for a time sufficiently long to allow them to become firm, is quite as important as the moving of them. As previously explained, teeth become firm in their new positions by virtue of a deposit of osseous material in the space created by their movement. The formation and perfect ossification of this new material is only completed after a lapse of time varying with the age and constitution of the individual. Experience has proven that a less time than six months should never be allowed for it, while in persons of mature age or in those younger where many teeth have been involved, the time will sometimes have to be extended to a year or longer.

The natural tendency of a tooth to return to its former position, aided by the tension of the parts that have resisted its movement, will certainly move a tooth from its new position unless the newly formed process has become thoroughly calcified, and is thus by its strength and density able to resist the opposing forces. Numberless failures to retain the good results of regulation are attributable to this cause alone.

In certain cases, as where a superior incisor has been occluding inside of the lower ones, or where a lower one has been biting outside of the upper ones, no retaining appliance will be required after it has been brought into proper position, because the natural occlusion of the jaws will prevent the corrected tooth from returning to its former position.

So also with the bicuspids and molars. Where malocclusion has forced them out of their true position, or kept

them there, the correction of the occlusion will often tend to retain them in their normal positions without extraneous aid.

In all other cases, however, mechanical assistance will be necessary until the teeth have become firm. Where the arch or any portion of it has been enlarged, or where a number of teeth have been moved from within outward, the simplest and probably the best means of retaining them will be the wearing of a thin rubber or metal plate covering the palatal arch and nicely fitting each tooth at its neck. It may contain a vacuum-chamber or not, as preferred, but in many cases the use of one will greatly assist in keeping the plate in place. In addition to its use in preventing teeth from moving inward, the plate may often advantageously be modified by the addition of a gold hook or spur to keep rotated teeth in position, or to retain individual teeth that have been moved inward.

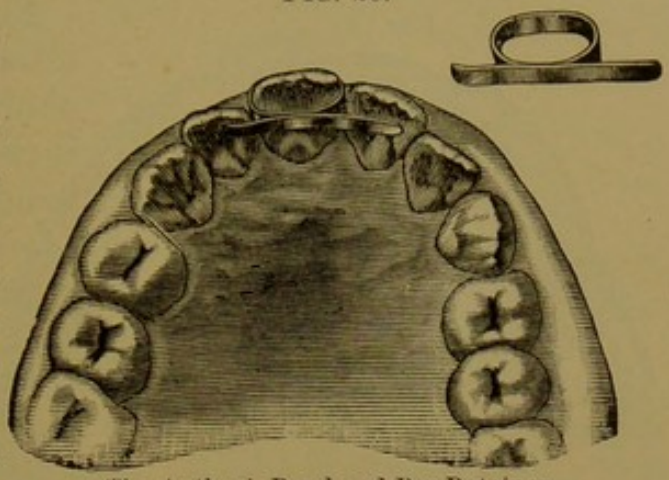
While rubber plates in some form, either by themselves or in combination with accessories, are frequently used for retaining corrected teeth, their use is, nevertheless, open to certain objections. All rubber plates, used either for correction or retention, must be removed at frequent intervals for cleansing. The very necessity for their removal affords opportunity for the patient to remove them at other times, and possibly forget or wilfully neglect to reinsert them for a longer or shorter period, thus causing delay in the reparative process.

Besides this, also, in the very act of removal and insertion the teeth are slightly moved in their sockets and this will to a certain degree hinder the reformation of tissue.

On account of these objectionable features the author has for many years avoided the use of rubber retaining plates, wherever he could do without them. As a substitute he was led to devise a number of little appliances of gold and platinum, occupying the least possible space, and firmly attached to the teeth for the required time. Fig. 28 shows one of these appliances in its simplest form. It consists of a platinum (Magill) band, freely fitted to the tooth, and having

a gold bar or spur soldered to it to press or bear against one or more of the adjoining teeth. When properly adjusted, it is secured to the corrected tooth by means of zinc phosphate.

Fig. 28.



The Author's Band and Bar Retainer.

As will readily be seen, its advantages consist in its small size, its slight contact with teeth other than the one upon which it is placed, its cleanliness, its fixedness and the firmness with which it holds the corrected tooth in place.

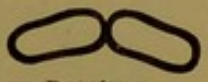
The latter is its most important feature, for it is a well recognized fact in surgical practice that re-union of bony tissue or new formation of the same will progress in rapidity proportionate to the immobility of the parts.

Fig. 29.

Retainer.

Fig. 29 shows a modification where two teeth are thus to be retained with the extension bar long enough to include more distant teeth. Fig. 30 represents metal bands joined at their points of contact, for the retention of two teeth that have been rotated.

Fig. 30.

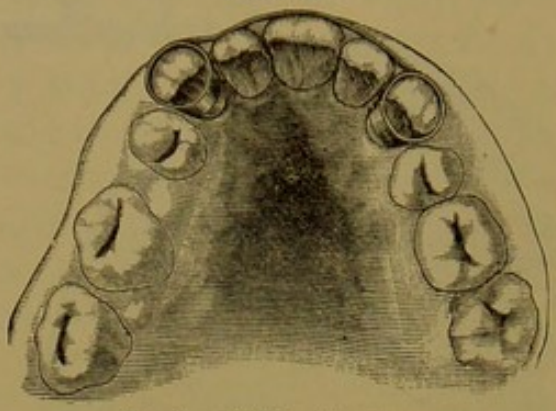


Retainer.

Any number of bands may be thus joined to form a retainer for a corresponding number of teeth, but where they occupy so much interdental space, the separations between the teeth are very unsightly after the retainer has been removed. A better plan is to employ but two bands, if possible, and allow extensions from these to support and steady any intervening ones. An illustration of one manner of doing this is shown in Fig. 31. In this case the two bands on the cuspids are united by a thin gold or platinum wire passing along and conforming in outline to the labial surfaces of the inter-

vening teeth. It was used to retain three incisor teeth which had been drawn inward.

FIG. 31.

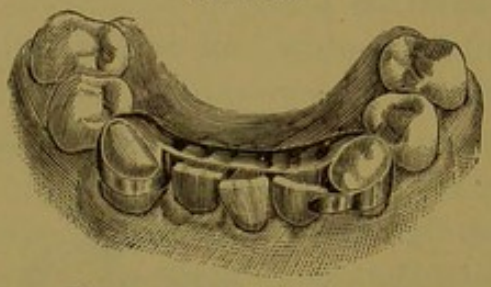


Band and Wire Retainer.

Fig. 32 illustrates a retainer of nearly similar character for the lower incisors. In this case a band of gold takes the place of the wire on account of its greater stiffness.

Retaining appliances of this character cannot, of course, be used to advantage in all cases; but where they can they will be found to be most satisfactory.

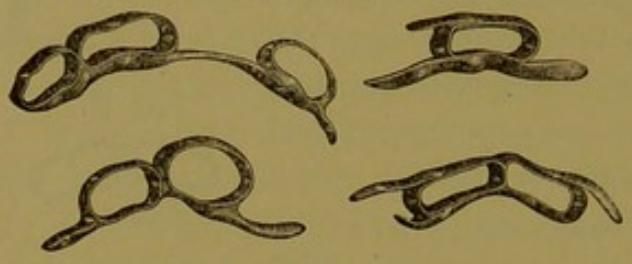
FIG. 32.



Retainer for Lower Incisors.

Fig. 33 represents a variety of retainers constructed on the band and bar principle, showing numerous modifications.

FIG. 33.



Retainers.

Prof. Angle uses a retaining appliance differing from the foregoing in having a tube soldered parallel with the band that encircles the tooth. The tooth once in position a wire is passed through the tube and made to rest upon the adjoining teeth, after which a hole is drilled through both tube and wire and a short pin inserted to prevent the wire from shifting its position. See Fig. 34.

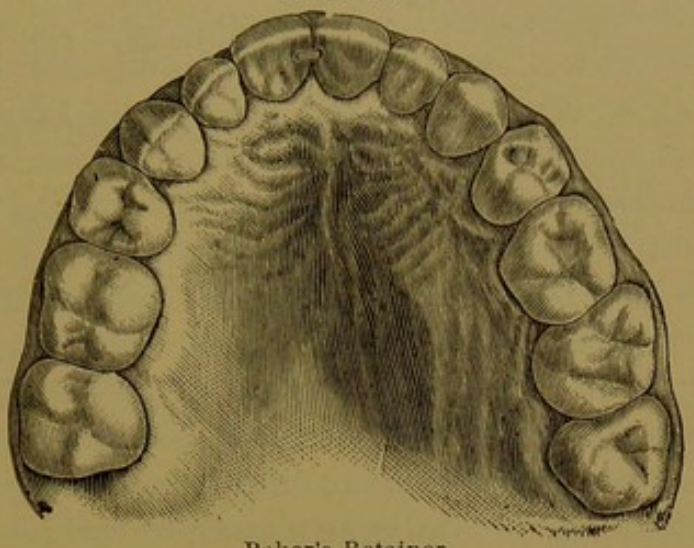
FIG. 34.

Angle's Retainer.

Another simple and ingenious device for retaining teeth after they have been moved, especially after rotation, was

shown the author by Dr. H. A. Baker. It consists of a gold screw cemented into some conveniently located cavity in such a way that the protruding portion shall rest against an adjoining tooth, and thus prevent the tooth operated upon from changing its new position. Such device could, of course, only be used in rare and exceptional cases, but where applicable, it possesses the advantages of simplicity, inconspicuousness and efficiency. Fig. 35 represents a case in which a rotated incisor was thus retained.

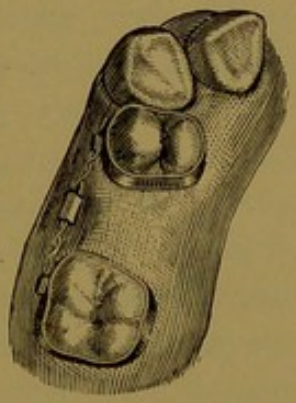
FIG. 35.



Baker's Retainer.

A very simple appliance for holding teeth which have been drawn toward one another is shown in Fig. 36, and was devised and first used by Prof. C. S. Case. It consists of a silver or platinum wire passed over lugs or pins upon bands attached to the teeth to be retained. Floss silk or China-grass line, used in the same manner would answer instead of wire, but it would neither be as strong nor as cleanly. Prof. Case also uses the wire for exerting a gentle tractile force where needed by soldering a piece of square metal tubing to it at about the middle of its length and turning this with a suitable instrument, thus twisting the wires and drawing the teeth together.

FIG. 36.



Retainer (Case).

CHAPTER III.

CONSIDERATION OF METHODS.

FARRAR'S METHOD.

In 1876 Dr. J. N. Farrar began publishing a series of articles in the *Dental Cosmos*, descriptive of a method he had devised for the regulation of teeth. Reading and observation, he said, had satisfied him that the various plans suggested up to that time for the correction of irregularity, were lacking both in system and principle. He claimed that the performance of so important an operation as regulation should be based upon a correct knowledge of both mechanical and physiological law.

Experience had convinced him that the character of force applied to the teeth should be *positive*, and that it should be *intermittent*—a period of rest following a period of motion.

The best instrument for applying a force that is positive and may be intermittent, he said, was the screw in one of its various forms.

Experimenting with appliances constructed upon the screw principle, convinced him that this method of delivering force was not only positive and direct, but also that its range of applicability was so great that it might be used to the best advantage in nearly all cases of regulating. He claimed, also, that it was the only instrument whose force could be controlled at will and thus be made to exert power upon or retain in a state of repose the tooth or teeth operated upon.

This alternation of motion and rest, he stated, was as important in changing the positions of teeth as in other organs of the body and was in strict accord with physiological law. In his experiments he found that intermittent

force was productive of less pain to the patient than continuous force, and might be so skilfully applied as to prevent all pain.

Pain, he said, was an expression of a pathological condition, and by its avoidance we kept within the boundary separating the physiological from the pathological state. With screws of known pitch and number of threads, he found that he could move a tooth painlessly, and therefore safely, from $\frac{3}{240}$ to $\frac{1}{160}$ of an inch every twenty-four hours. His experiments led him to the following conclusions:—*

"*1st.* That in regulating teeth, the traction must be intermittent, and must not exceed certain fixed limits.

"*2d.* That while the system of moving teeth by elastic rubber apparatus is unscientific, leads to pain and inflammation, and is dangerous to the future usefulness of the teeth operated upon, a properly constructed metallic apparatus, operated by screws and nuts, produces happy results, without pain or nervous exhaustion.

"*3d.* That if teeth are moved through the gums and alveolar process about $\frac{1}{240}$ of an inch every morning, and the same every evening, no pain or nervous exhaustion follows.

"*4th.* That while these tissues will allow an advancement of a tooth at this rate ($\frac{1}{240}$ of an inch), twice in twenty-four hours, the changes being physiological, yet, if a much greater pressure be made, the tissue changes will become pathological."

The above conclusions were epitomized by him as follows:—"In regulating teeth, the dividing line between the production of physiological and pathological changes in the tissues of the jaw is found to lie within a movement of the teeth acted upon, allowing a variation which will cover all cases, not exceeding $\frac{1}{240}$ or $\frac{1}{160}$ of an inch every twelve hours."

**Dental Cosmos*, Vol. XVIII., p 23.

His articles upon the subject may be found in the *Dental Cosmos*, extending from Vol. XVIII. to XXIV.

Although the screw principle was the one which he principally used, and the only one which he considered scientifically and physiologically correct, he at times availed himself of the use of some of the continuous-force appliances, such as rubber bands,* silk or fibre ligatures,† and, for the attachment of appliances, vulcanite plates.‡

The multiplicity and variety of Dr. Farrar's appliances and the ingenuity displayed in their devising, have commanded the admiration of all and been of great value to laborers in this field. Most of his devices are original in design, and well calculated to perform the work intended, but in confining himself so largely to the use of one form of power-producing instrument his apparatus is in many cases very elaborate and complicated. The same end could often be accomplished by much simpler means.

His appliances are so numerous that illustrations of many of them could not be introduced into a text book, nor could they well be selected from to illustrate his principles, but some of them may be found in Part III., where the practical treatment of various forms of irregularity is considered.

Dr. Farrar has recently published in book form a full elaboration of his views and methods, together with numerous illustrations of his appliances, to which the reader is referred.

THE MAGILL BAND.

This device, while not properly constituting a method, is considered here, because through its great value it has come to be an important factor in several methods of regulating devised since its introduction. Dr. W. E. Magill, having in common with other practitioners experienced the difficulty

* *Cosmos*, Vol. XIX., p. 520.
† " " XXI., " 306.
‡ " " XXI., " 306.

of attaching regulating appliances to the natural teeth in such a way that they would have a firm hold and not slip, devised the following plan of meeting and overcoming the difficulty:—

From a piece of platinum, German silver or platinous silver plate, No. 28 (B. and S.) gauge in thickness, he cut a strip about a line in width and bending it to conform to the shape of the tooth soldered it at the point where the ends overlapped, thus converting it into a band or ferrule. After attaching to this band any studs, pins or hooks that the case demanded it was lined with oxy-chloride of zinc and slipped over the dried tooth to a point about midway between the cutting edge and neck.

Since the introduction of phosphate of zinc, it has been found to be a far better medium for the attachment of the band to the tooth than the oxy-chloride of zinc, formerly used. Once in position, the cement will harden in about five minutes, after which no ordinary force will be able to dislodge it. If a wire spring is intended to rest against and press upon a banded tooth, a hole or pit should be drilled in the band at a suitable point, before it is cemented in place. If rubber bands or ligatures are to be employed, suitable provision for their easy attachment may be made by previously soldering to the band a small gold hook or a headed platinum pin taken from a porcelain tooth. Where a screw-jack is to be used in the moving of a tooth, an abutment of platinum should be soldered to the band encircling the resisting tooth, and then be slotted to receive one end of the screw. The band of the tooth to be moved should also be reënforced and drilled to accommodate the point of the screw.

When the operation is completed, or when for any cause it may be desired to remove the band, it is easily accomplished by protecting the enamel at the cutting edge of the tooth with a folded napkin or piece of chamois skin, and placing one beak of a pair of pliers upon it and the other upon the

upper edge of the band, the closure of the hand will dislodge the appliance without in the least marring or altering its form. By this simple invention one of the greatest difficulties hitherto experienced in regulating has been overcome, and its devising has almost introduced a new era in regulating. For the purpose intended there is nothing that approaches it in efficiency.

Before its introduction attachment to the tooth to be moved was usually effected by means of a ligature ingeniously applied and made fast by some form of knot, or a pit or hole was drilled into the substance of the tooth to receive the point of a screw or other device and prevent it from slipping. The knots would often slip and the drilling of pits was objectionable, so that the difficulties of securement were not overcome until the invention of this band.

By its use absolutely secure attachment and anchorage are obtained and the moving of teeth is accomplished with far greater exactness than had previously been possible. When attachment was made by ligature it was often necessary that the ligature should encircle the tooth at its neck, and when not necessary to place it there it would often slip into that position owing to the shape of the tooth. The irritation of the soft tissues thus produced was frequently the cause of much pain to the patient. The Magill band obviates this by preventing any fixtures attached to it from coming in contact with the delicate and sensitive mucous membrane of the gum.

Indeed, the author has found that by its use nearly all the pain of regulating has been done away with, for the pain attendant upon regulating by the old methods was caused not so much by the slight irritation induced by the moving tooth as by the impingement of ligatures, rubber bands and other appliances upon the soft tissues. The Magill band may therefore, we think, be credited with having done more to modify the pain accompanying regulation than any other device ever introduced.

In some methods of regulating, such as Farrar's and Angle's, attachment is made to the teeth by means of an open band of gold secured to the teeth by a nut and bolt operating upon the free ends of the band. Such device, while valuable, is more complicated, cumbersome and less cleanly than the Magill band. It is also open to the objection previously noted, that of allowing the secretions to remain between the tooth and band.

Several of the author's methods of modifying the form of the band by means of attachments to increase its usefulness, are illustrated in Part III.

ANGLE'S METHOD.

This method of regulating was first brought to the notice of the profession by its originator, Prof. Edward H. Angle, in a paper read before the dental section of the Ninth International Medical Congress, held in Washington, D. C., September, 1887.

The appliances used are mostly made from German silver, although the levers are of steel and the retaining wire of gold. German silver is strong, easily adapted and inexpensive, while the steel piano-wire combines strength and elasticity with lightness and delicacy.

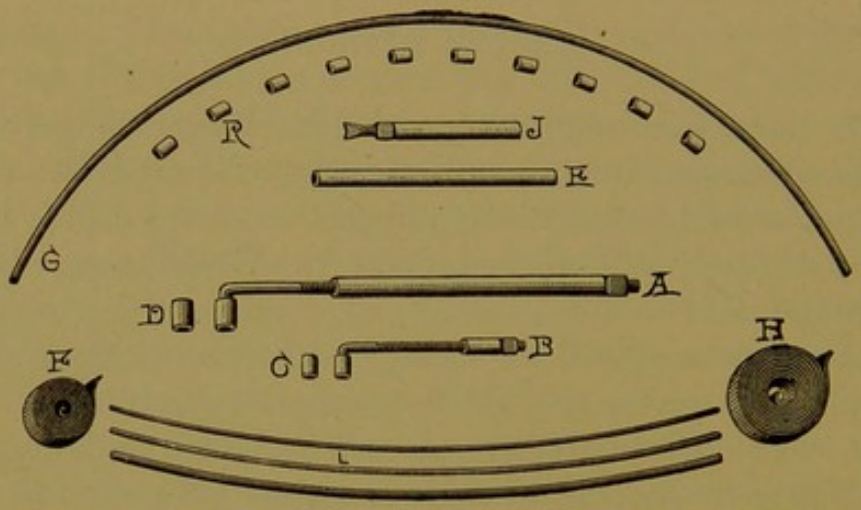
Power is obtained by the well-known mechanical principles of the screw and spring, while support or resistance is gained by firmly attaching the parts to the teeth by the Magill band, which is cemented in place, or by an adjustable clamp band.

The appliances are few in number, simple in design, and easily applied; qualities that add materially to the value of any device for general use. Prof. Angle, in describing his method, says:—

"Fig. 37 shows the simple appliances from which all the various combinations used in the original method may be made. "A" is a large traction screw encased in its accom-

panying tube, and used for pulling where the resistance is great. "B" is a smaller traction screw, used in the same way where the resistance is slight, or where from any reason a delicate appliance is desired. "C" and "D" are tubes which are soldered to bands placed upon the teeth to be moved, into which the ends of the traction screws are hooked. "J" is a jack-screw, used for pushing, the end of which is beaten flat. "E" is an extra piece of tubing, by means of which a longer jack-screw can be made. "F" and "H" are coils of band material of different thicknesses. "G" is a gold wire used in retaining the teeth and also to assist

FIG. 37.



Angle's Appliances.

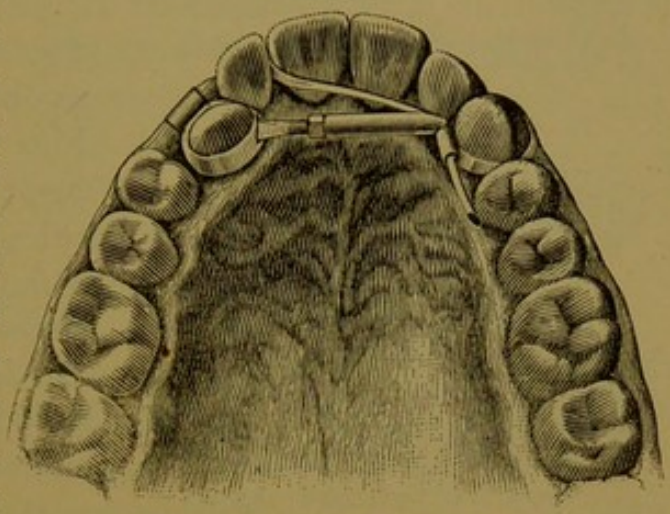
in securing anchorage in some cases, and "RR" are small retaining tubes, into which the retaining wire accurately fits, and are designed to be soldered to bands. "LL" are lengths of piano-wire of varying sizes, giving different degrees of power.

"Aside from the advantages of simplicity, efficiency and cleanliness, which are insured by these appliances, a still greater desideratum is gained by means of the mechanical principles observed in their construction. Stationary anchorage and non-relinquishment of pressure are prominent features of this method, and are certainly secured almost to perfection.

"A few of the principal movements are selected for illustration from the many modifications of which the appliances are capable.

"The application and operation of the direct screw is shown in Fig. 38. A firm anchorage for the resistance of the screw is obtained by banding and tubing the left cuspid, and passing through the tube a piece of gold or German silver wire long enough to extend to and rest against adjoining teeth. The opposite cuspid is banded, and a retaining tube soldered to the labial surface. The lingual surface has a slot cut in it to receive the flat end of the screw-jack. The other end of the tube, in which the screw plays, is so filed that it rests securely against the reënforcement wire and the tube upon the lingual surface of the cuspid band. After being brought into position the tooth is held in place by passing a short piece of gold wire through the retaining tube on the labial surface, which is left in place until the tooth is firmly set in its new position.

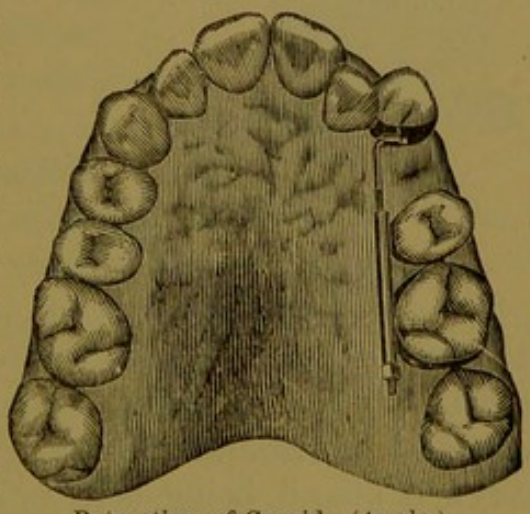
FIG. 38.



Re-enforced Anchorage. (Angle.)

"The backward movement of teeth in the line of the arch is accomplished by the appliance shown in Fig. 39. The second bicuspid and first molar are banded, and the tube of the heavy

FIG. 39.



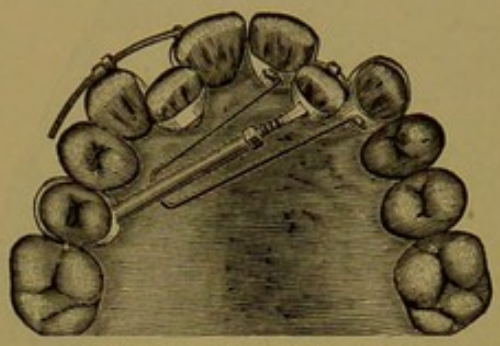
Retraction of Cuspid. (Angle.)

traction screw rigidly soldered to the bands. The cuspid to be moved is banded, and a short section of tubing soldered to it to receive the end of the traction screw.

On turning the nut traction is produced and the cuspid drawn into place. The cuspid is kept from being rotated while it is being moved backward, by means of the short tube accurately fitting the right-angled end of the traction screw.

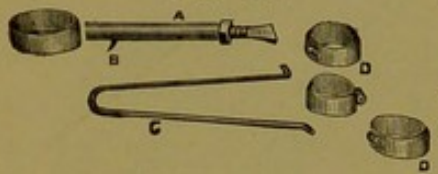
"Another outward movement of a tooth by means of the screw-jack is shown in Fig. 40. The second bicuspid is made the principal anchorage, against which the base of the tube rests. The band encircling the lateral incisor has a slot cut in it to receive the end of the screw-jack. The anchorage is reënforced by means of a wire loop, which hooks into tubes upon the adjoining central and cuspid, and is looped over a spur upon the body of the screw-jack tube. The central and cuspid cannot be pushed outward on account of this reënforcement, and three teeth constitute the anchorage instead of one. The several parts of this appliance are shown in Fig. 41.

FIG. 40.



Reciprocal Anchorage. (Angle.)

FIG. 41.

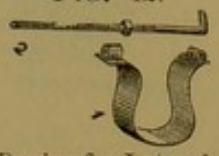


"Outward movement, as accomplished by another simple means, is as follows: A thin strip of band material is looped about the malposed tooth, the ends resting upon the labial surfaces of the adjoining teeth. To one end of this strip is soldered a tube placed vertically, while to the other end a similar tube is attached horizontally. Into these tubes the small traction screw is placed, being bent to conform to the shape of the arch, and used in this case to push instead of pull. The

parts of this device are shown separately in Fig. 42. The manner of retaining the teeth in position, after correction, is shown in Fig. 43.

"Rotation by this method, as in most others, is accomplished by the elasticity of a metallic bar or wire attached to the tooth to be rotated, and then sprung around to some firmer tooth or teeth at a distance. Fig. 44 shows a lateral to be rotated, and the appliance in position by which it may be accomplished. The lateral is banded and tubed as shown in the cut. The second bicuspid is also banded, and to secure greater resistance, the two adjoining teeth are made to assist by means of a wire which passes through a tube on the palatine surface and rests against the first bicuspid and first molar. On the buccal side of this same band, the ends of the band material are shaped into a latch or hook, with which the rotating spring engages when it is sprung around. The several parts of this appliance are shown in Fig. 45. After the tooth is in position, it is retained by means of a short wire passing through the tube, and extending upon the central, as seen in Fig. 46. This wire is kept in place by a small pin, which is tightly fitted in a small hole drilled through both tube and wire, as shown.

FIG. 42.

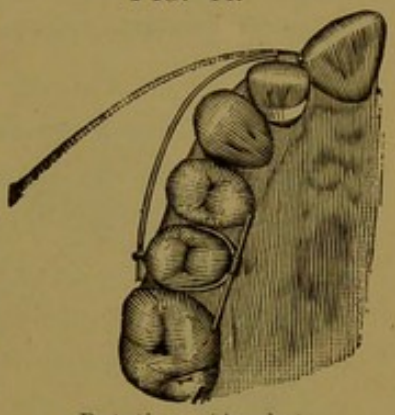


Device for Lateral Movement.

FIG. 43.

Retention.

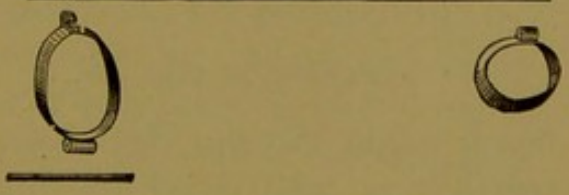
FIG. 44.



Rotation. (Angle.)

"When two teeth are to be rotated in opposite directions at the same time, as the central incisors, double rotation may be accomplished by one appliance, as shown in Fig. 47. Both teeth are banded, and a

FIG. 45.

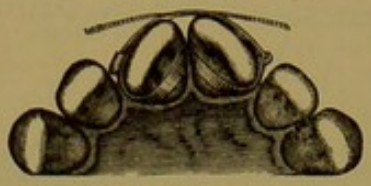


tube soldered to each band, one being horizontal and the other vertical. A piece of piano-wire is bent to a right angle at one end, and then placed in position as seen in Fig. 48. The tendency of the wire to straighten itself, will rotate both teeth at once. When in position they are retained by substituting a non-elastic gold wire for the piano-wire.

Fig. 46.

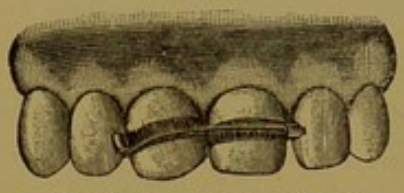
Retainer.

Fig. 47.



Double Rotation. (Angle.)

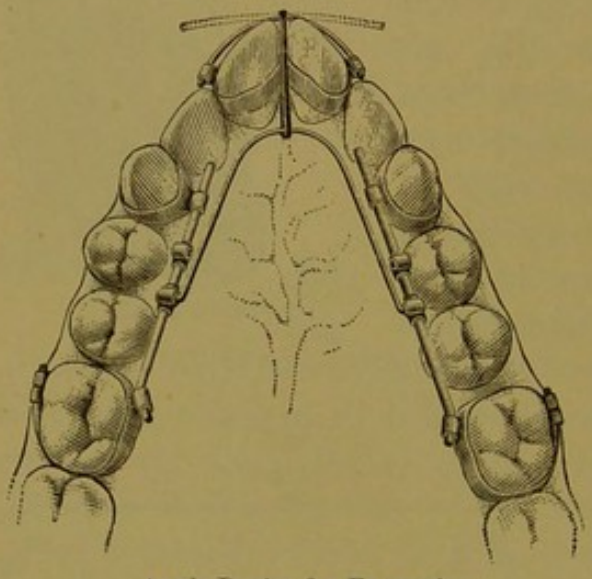
Fig. 48.



Double Rotation. (Angle.)

"Expansion of the arch is accomplished by banding and tubing the first and last teeth of those to be moved, on each side, and connecting them by means of a wire passed through the tubes. To these wires, at suitable and varying distances, are soldered short tubes to accommodate the ends of the piano-wire spring which is bent to conform somewhat to the shape of the arch. While the spring does not give us the power and direct action of the screw-jack, it is in many cases sufficient and avoids interference with the tongue.

Fig. 49.



Angle Device for Expansion.

"Fig. 49 shows the appliance in position, which is as applicable to the lower teeth as the upper."

Retention is anticipated and provided for, by means of the tubed band, while the pin device for locking spring and tube together, is both novel and ingenious. Aside from these,

the method contains so many ingenious modifications of previously known devices (as the screw and band), and is composed of parts so simple and direct in their action, that it must necessarily commend itself to all engaged in this line of practice. Other illustrations of this method are shown throughout Part III.

The various parts of the Angle appliances may be obtained from dental supply houses.

COFFIN'S METHOD.

In a paper read before the Dental Section of the International Medical Congress, held in London, in August, 1881, Mr. Walter H. Coffin explained his method of correcting irregularity of the teeth. The method was devised by his father, and had been in use by father and son for twenty-five years. It was termed the "Expansion Method," because in nearly all cases coming under their care a certain amount of expansion had been found necessary in connection with other desired movements.

The construction of the appliance and the principle upon which it acts are exceedingly simple. The power is derived from the elasticity of piano-forte wire, attached in various ways to a vulcanite plate which covers the arch (in an upper case) and envelopes the posterior teeth on either side to give it firmness and fixedness in position. When it is desired to expand the superior arch, the wire is bent into the form of a double U, lying on top of the plate with the ends embedded in it.

To produce lateral expansion in the lower jaw, the form of the appliance is necessarily different. A simple vulcanite plate is made in horse-shoe form, fitting the gum and lingual surfaces of the teeth, and capping the molars and bicuspids. On the lingual surface of this plate, lie two pieces of piano-wire suitably curved, with their ends embedded in the rubber.

Each of these plates, when completed, is sawn in two along the median line, thus allowing the tension of the wire to be increased from time to time by spreading apart the sections of the plate.

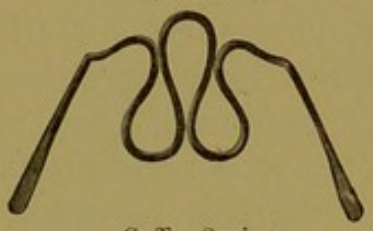
The piano wire used may be obtained from piano factories or from dealers in dental supplies. It is made from the best quality of steel, drawn to size through draw-plates. The quality of the steel, as well as the toughness of the wire, is greatly improved by the successive drawings to which it has been subjected. For ordinary cases Mr. Coffin recommends that the diameter of the wire be between three and four one-hundredths of an inch. A lighter or heavier number will yield respectively less or greater pressure.

In use it should not be annealed, but bent to shape as it comes. Mr. Coffin recommends that the wire be tinned after being bent to shape, to prevent oxidation in the mouth, but this does not appear to be necessary.

A wire suitably bent to produce expansion of the superior arch is represented by Fig. 50.

The details of the construction of an expansion plate for the superior jaw, are as follows: From an accurate impression of the jaw and teeth, taken with plaster or modelling compound, a plaster model is obtained. Upon this a wax base-plate is fashioned, to cover all parts intended to be covered by the completed plate. The suitably bent wire is now further shaped so that it will lie upon the exposed surface of the base-plate and conform to it as closely as possible in outline. After the ends of the wire are attached to the base-plate by means of additional wax, a piece of tin-foil (No. 60) is slipped between the wire and the plate and its corners bent, so that the plaster when poured into the flask will grasp and remove it with the wire. The foil is placed there so that the plate will have a polished surface under the wire

Fig. 50.



Coffin Spring.

after vulcanization. The wax base-plate should now be smoothed with a spatula and flasked in the usual manner. In separating the flask, the wire and tin-foil will come away with the upper half, while the model will remain in the lower. After removing the wax and packing the rubber, the case is vulcanized, after which it is polished. The completed piece should now be properly fitted to the patient's mouth, and the rubber covering the masticating surfaces of the posterior teeth so filed and dressed that the cusps of the occluding teeth will all strike the rubber at the same time.

However many or few of the natural teeth be covered the last ones in the arch must always be included, as otherwise they will elongate through non-occlusion and thus seriously impair the usefulness of the masticatory apparatus. After the plate has been fitted it should be sawn in two with a jeweler's fine saw, the edges made smooth and slightly rounded, and the case introduced into the mouth.

It is desirable to have the patient wear the plate for a day without enlargement, after which, at intervals of a day or two, the tension of the wires should be increased by pulling the halves of the plate apart sufficiently to slightly increase the space between them. When the wire is heavy, as is necessary where great force is to be exerted, it can be best formed into shape and afterwards altered as required by means of the ordinary clasp-bending pliers. The construction of the lower plate is substantially the same, but the wires lie against the plate in a continuous smooth curve, instead of being corrugated.

Figs. 51 and 52 represent an upper and lower expansion plate as described. For cases where expansion is not needed, but simply the moving of one or more teeth, Mr. Coffin uses a solid rubber plate with wires so placed as to produce the desired movements. The construction of this form of plate is the same as those just described, with the exception of the shape and arrangement of the wires and the non-separation of the plate.

A single long piece of wire, bent at right angles near one end and flattened at the other, is embedded at its flattened end into the plate, while the other end, and a long portion besides is free and lies in close contact with the plate. Before the wire is attached to the wax base-plate, the plaster tooth representing the one to be moved should be cut away close to its neck and the bent end of the wire laid upon it so as to cover the entire diameter of the stub tooth. In this position it is vulcanized to the plate.

Fig. 51.

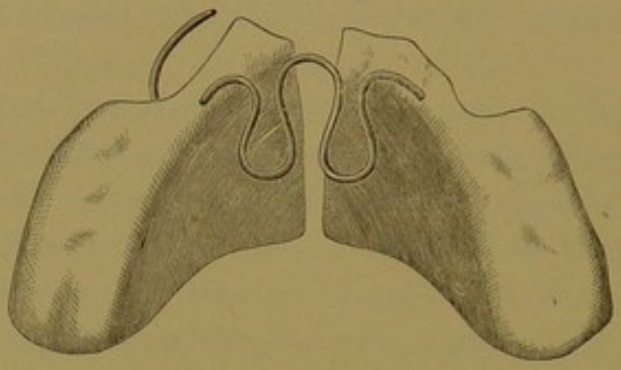
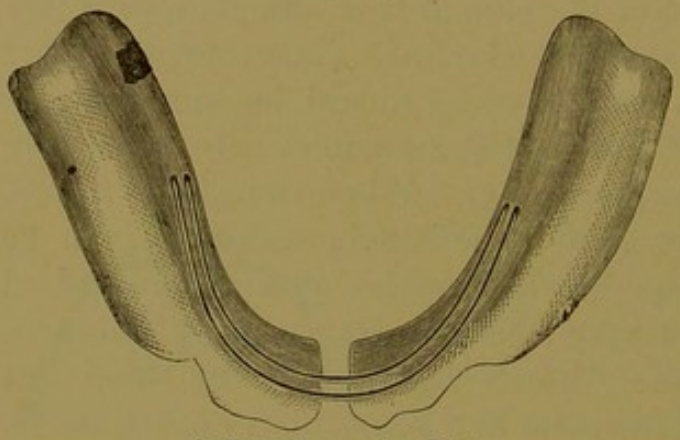


Fig. 52



Coffin's Expansion Plates.

When the plate is introduced, the wire will have to be drawn back with an instrument or string before the plate will go into position. Once in place and the wire released continuous pressure will be exerted on the malposed tooth. After the tension of the wire has been lessened by the moving of the tooth, it may be increased either by bending the wire where it enters the plate or by cutting it out and re-setting in a different position.

Another and very convenient way of lengthening the wires to follow the moving tooth, is to slip a section of platinum or German silver tubing over the end of the wire and soft-solder it in position.

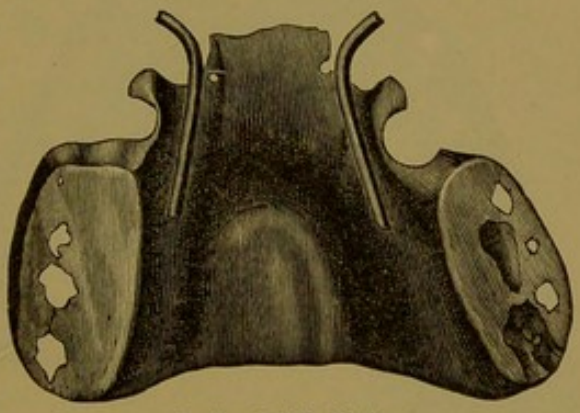
Where a tooth is to be pressed outward the wire is anchored in the palatal portion of the plate, but where a tooth is to be moved from without inward, the wire should be attached to that portion of the plate covering the buccal surfaces of the molars.

Rotation is accomplished by combining the two movements; that is, by having one wire on the palatine surface to press against one angle of the tooth, and another on the buccal surface to press against the opposite angle.

Two wires can be inserted to operate on two teeth at the same time, either in similar or opposite directions. Fig. 53 represents a plate made to press outward two lateral incisors.

Many modifications of the Coffin plate have been devised by different practitioners, some of which are shown in Part III.

FIG. 53.



Coffin Solid Plate.

The originator claims for his method and appliance, simplicity, ease of construction and inexpensiveness, almost universal range of application, perfect control of force applied and direct action, comparative painlessness from non-irritation of the soft tissues, perfect fixedness and least unsightliness, ease of removal for cleansing, and little interference with speech and mastication.

JACKSON'S METHOD.

Appreciating the values of piano-wire as a power-yielding material, as shown in the Coffin method, and realizing the advantage in most cases of dispensing with the use of a plate, Dr. V. H. Jackson was led to devise a method of constructing regulating appliances in which piano-wire was the principal and almost the only material employed.

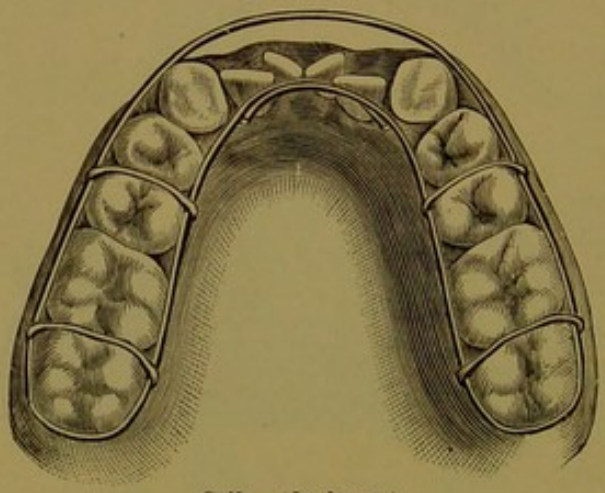
By suitably bending a length of this wire, of medium thickness, in such a way as to pass around the buccal and lingual surfaces of all the teeth in one of the arches and joining these portions at convenient distances by short connecting wires, a "crib" or skeleton-wire fixture was formed that hugged the teeth and held itself firmly in place.

To this, as a foundation, additional wires were attached of such length and shape as to bear and produce pressure upon any teeth in the same arch which it was desired to bring into proper position.

Fig. 54 shows the general appearance of the "crib" in its simplest form.

In constructing the appliance, the plaster teeth of the model are first scraped near their necks on both the buccal and lingual surfaces so that the crib, when formed, will have to be sprung into place. The wire is now bent by means of flat- and round-nosed pliers so as to conform to the outline of the teeth and touch all of the included ones at their necks.

Fig. 54.



Crib. (Jackson.)

To keep the crib from impinging upon and irritating the gum, short wires (as before stated) are formed to lie in the depressions between the masticating surfaces of certain teeth and are attached to the main wire upon both the buccal and lingual sides. These connecting wires are joined to the base wire by having their ends bent so as to grasp them, after which the joints are secured by means of soft-solder fused either by the blow-pipe or soldering iron while the parts are in position on the model. Before soldering, the joints will have to be touched with dilute muriate of zinc, commonly

known as soldering fluid. Wrapping the joint with thin copper strips as shown in Fig. 55, before soldering greatly facilitates the operation.

The crib once properly formed, additional wires for producing pressure at any point and in any desired direction are added to it in the same manner.

Fig. 55.

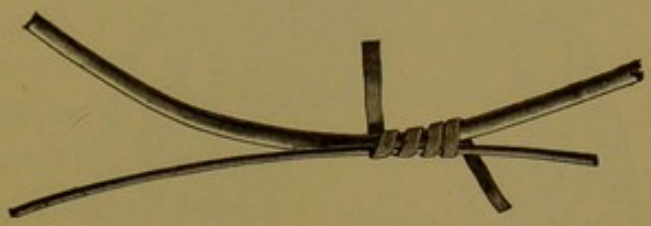
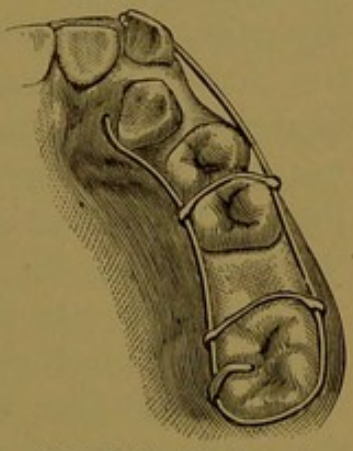


Fig. 56 shows a crib formed for and attached to but one side of the arch for the purpose of forcing a cuspid outward and a lateral inward into line at the same time.

In some cases the end of the wire producing pressure is best secured in position by being soldered to a band to be cemented to the tooth to be moved, as shown in Fig. 57.

Fig. 56.



Side Crib. (Jackson.)

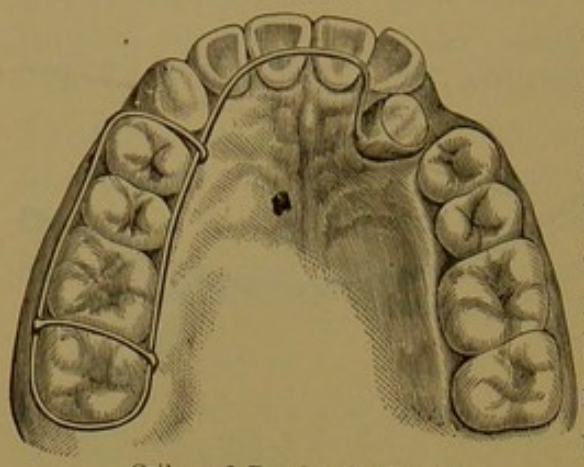
While the appliance thus constructed is firmly held in place by hugging the teeth above their most prominent portions it is at the same time readily removed for the purpose of bending the wire springs or for alterations or new attachments.

Dr. Jackson has simplified and improved his appliances by discarding the crib formed of a continuous piece of wire (which was oftentimes difficult to construct) and obtaining his anchorage by wire and metal attachments to individual teeth instead, as shown in Fig. 58.

In constructing these anchorage appliances, he first cuts from thin gold, block tin, tinned copper, German silver or Tagger's tin a piece large enough to cover the lingual portion of the anchor tooth and contours it with the contouring

pliers used in crown- and bridge-work. A wire crib for the same tooth is then made from a piece of No. 20 piano-wire by "first bending it at right angles (Fig. 59), leaving the width between the parallel sides equal to the antero-posterior width of the tooth to be clasped. The part that is to clasp the neck of the tooth is then so bent with clasp-benders that it will be perfectly adapted to the curve of the labial side of the tooth. (Fig. 60.) Both arms of the wire are then bent at nearly a right angle at a proper distance to cause them to pass over the grinding surface of the tooth, and again bent in the same manner to extend toward the neck of the tooth on the lingual side. Fig. 61.

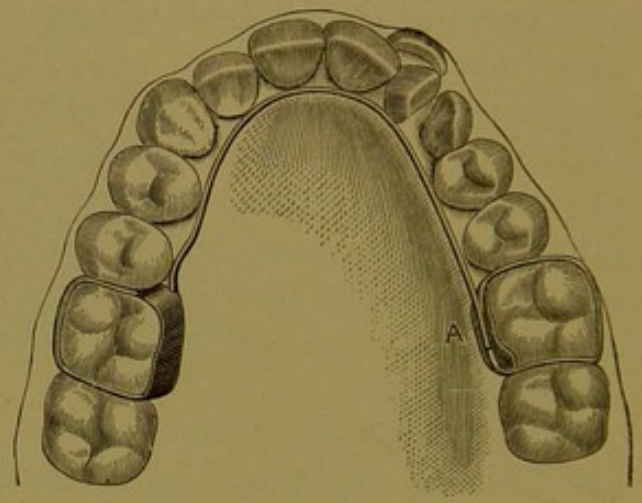
Fig. 57.



Crib and Band. (Jackson.)

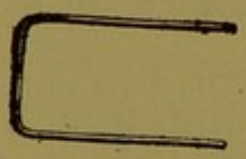
"The ends are next bent toward each other near the gum line over the piece of metal previously described, as seen at A in Fig. 58, and tacked with soft solder."

Fig. 58.



Anchorage. (Jackson.)

Fig. 59.



If the wire spring is to be attached to the teeth on the opposite side of the arch a similarly constructed crib should be made for that side. With these two cribs in place on the plaster model the connecting wire, after being suitably shaped, is laid in position and firmly held while all are

joined together with solder. The soldering is most conveniently accomplished by moistening the parts with dilute muriate of zinc, laying upon each joint a piece of soft solder of suitable size and fusing with a soldering iron. After this any wire springs that may be needed are attached in the same manner.

Fig. 60.

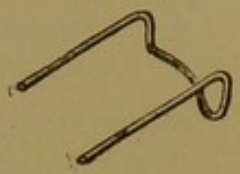
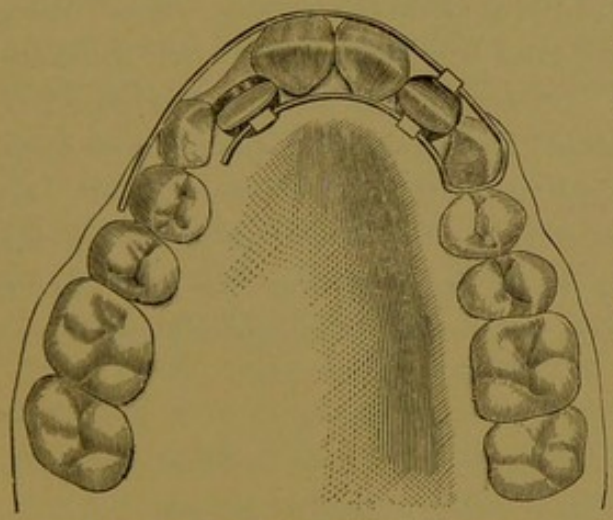


Fig. 61.

The entire appliance being thus formed of separate parts and joined together while in position on the model assures accuracy of fit that could not well be obtained in any other manner.

In other cases, where it seems advisable, instead of a crib made of plate and wire as described, attachment to the anchor teeth is made by means of a metal band or collar encircling the tooth, to which sections of metal tubing or lugs are attached for the accommodation of the spring wire, as shown in Fig. 62.

Fig. 62.



Wire and Band Appliance. (Jackson.)

Some of the numerous ways in which these combination appliances may be adapted to the correction of many forms of irregularity are shown in connection with the practical treatment of cases in Part III.

Dr. Jackson claims for his method the following advantages:

1. "The materials are inexpensive and within the reach of all."

2. "The crib and spring construction is simple and quickly done."

3. "The clinging grip of the crib on its anchorage is sufficient to hold the fixture firmly, yet it is easily sprung off for cleansing or change."

4. "Changes or additions are easily and quickly made."

5. "The structure is light, cleanly and occupies the least possible space in the mouth."

6. "Its action is controllable and free from risk of over-action."

7. "It forms a perfect retainer."

Dr. Jackson has recently made some important changes in the materials used in the construction of his appliances. Finding that piano-wire and Tagger's tin readily corroded in the fluids of the mouth and produced unsightly stains upon the teeth with which they were in contact, he has almost entirely discarded their use. In their stead he now employs gold, platinoid and German-silver, uniting them by gold or silver solder or by soft solder.

For partial clasps or collars he prefers gold-faced platinum; for spring-wires, platinous gold (clasp metal); while for base-wires he uses platinoid. He finds that platinoid wire, when well drawn, possesses qualities more like piano-wire than any other metal or alloy and tarnishes very little. He sometimes, also, uses platinoid in the form of plate for partial clasps, collars, caps, lugs, etc., plating the appliances, when desirable, with gold. For this he employs the Pohlman gilding solution.

PART III.

SPECIFIC FORMS OF IRREGULARITY AND THEIR TREATMENT.

While principles and methods may be well understood, illustrations of their application in certain forms of irregularity will be necessary in order that the student may properly comprehend their practical relationship.

So far as ease or difficulty of treatment is concerned, cases of irregularity are naturally divided into two general classes; in one, the cases are brought to our notice as soon as the irregularity begins to manifest itself, while in the other, the deformity is fully established and confirmed before presentation for treatment. In the first case, occurring usually in children, we have the advantages of easy movement and freedom from complications; while in the second, we have to contend with slow and difficult movement and a variety of unfavorable conditions.

For these reasons it is deemed advisable to treat of certain forms of irregularity, especially those involving the six anterior teeth of each jaw, under separate heads, according as they present before or after dentition is complete, for the treatment in one case will vary considerably from that required in the other.

CHAPTER I.

INCISOR TEETH SITUATED WITHOUT OR WITHIN THE LINE OF THE ARCH.

Reference has already been made to the fact that normally the permanent inferior incisors erupt inside of the line of the arch and posteriorly to the deciduous ones, while the permanent superior incisors erupt outside of their deciduous predecessors. From the limited space allotted to them, there is a stronger tendency to irregularity on the part of the lower incisors than there is on the part of the more favorably located superior ones, although the latter are also often found in a crowded condition, sometimes complicated with torsion.

So long as the inferior ones are inside of the arch, even though irregularly arranged, they will usually need no attention on our part until dentition is complete, and when that time arrives it will generally be found that nature has almost, if not entirely, corrected the condition.

So also, where some of the superior incisors erupt slightly outside of the line of the arch, they being still in line with spaces between them, we need not interfere, for in most cases the force exerted by the lips and the erupting cuspids will bring them into normal position and relationship.

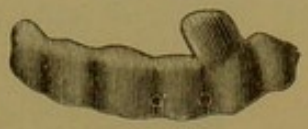
It not unfrequently happens, however, that from some cause a superior incisor is deflected in its eruption and appears inside of the arch, or that an inferior incisor is found to erupt outside of the arch. In either case, treatment is indicated as soon as the irregular tooth or teeth are sufficiently erupted to enable us to bring the proper force to bear upon them.

One of the earliest methods employed for releasing an

inlocked superior incisor was that known as the "saddle and inclined plane," one form of which is shown in Fig 63.

The *saddle* was usually formed of metal, struck up to fit and cover all of the lower incisor teeth. To this, at some point of the ridge, was soldered an inclined piece of heavy metal so arrranged that the inlocked tooth would strike upon it in mastication and be forced outward into line.

FIG. 63.



Inclined Plane.

Later the appliance was often made of vulcanite, and while in either form it generally answered the purpose of correcting the simple irregularity, it was objectionable on account of its size and because it was removable and thus liable to be lost or laid aside and not worn.

A modification of and improvement upon the old form, retaining its virtues and obviating its disadvantages, was devised by the author many years ago. By its use, when attached to a single tooth, a double movement is produced, for while by the action of the plane the superior inlocked tooth is moved outward, the lower outstanding one, to which the plane is attached, is moved inward. When it is not desired to move the lower tooth it can be prevented by making the appliance to include two or more teeth and thus offer more resistance.

It is constructed as follows: A band of thin platinum, gold or German silver plate (No. 29, B. and S. gauge) is bent to encircle and fit the protruding lower incisor, and the ends soldered. A piece of ordinary gold plate is then bent double to form an inclined plane, and spread apart at its ends to grasp the band on the lingual and labial surfaces, to which it is soldered. It is next placed upon the tooth to see that the adjustment is correct, removed, lined with phosphate of zinc, and pressed permanently into position. If the teeth are in close contact it is well to allow the fixture to be worn a day previous to cementing, for then the teeth will have been pressed apart and the replacement with cement will be

more easily accomplished. The cement not only lines the band, but fills all the space between the inclined plane and the tooth, thus giving greater resistance and strength in biting. It is shown in position and separately, in Fig. 64. Its advantages are its small size and absolute fixedness. When the correction has been accomplished, it will be necessary to cut the band in order to remove it. Two objections have been urged against the employment of inclined planes in any form: one, that by thus opening the bite, the posterior teeth will elongate; the other, that the patient may avoid biting upon the plane and thus defeat our object. These objections have no real validity, as is shown by actual experience.

Fig. 64.

Fixed Plane.

The short time that the bite is open, usually only a week or two, is not long enough to permit of any perceptible elongation, while the patient must and does bite upon the plane in mastication, because it is the only point where occlusion is possible.

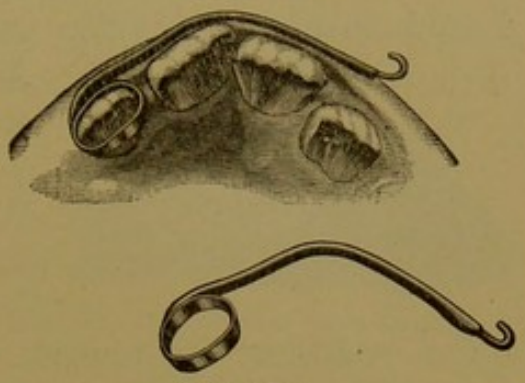
Another plan of accomplishing the same end has been suggested by Prof. C. N. Peirce. He attaches ligatures to several or all of the lower incisors, and makes these fast to the molars on either side. The ligatures being attached and drawn tight while dry, will, under moisture, contract and draw the incisors inward. This operation is continued until the lower incisors reach a position inside or back of the malposed superior ones. The ligatures are then removed, and the lower teeth, in gradually resuming the position they formerly occupied, will carry the inlocked superior ones with them.

A simple way of moving inlocked laterals outward is to solder one end of a platinous gold bar to a platinum band made to encircle one of the laterals and attached to it by zinc cement. Arranged in this way, the bar has but one free end, which is more readily ligated to the other lateral.

Fig. 65 illustrates an appliance of this character, which

was used to bring out into position two superior laterals in the mouth of a girl ten years of age. The case was complicated by one of the centrals being slightly turned upon its axis.

Fig. 65.



Spring Bar.

A platinum band or collar was made to fit the right lateral, and to its labial surface was soldered one end of a bar of spring gold, long enough to extend over the centrals and cover the opposite lateral. The bar was converted into a hook at its free end and so shaped that in its course it touched only the prominent edge of the twisted central. The band was then cemented to the right lateral, and a section of small rubber tubing passed under the left lateral and caught in the hook. The appliance thus operated in two ways: First, to bring the laterals out into line; and next, to press backward and inward the protruding corner of the central.

In other cases, where the centrals are in proper position and the laterals are inside of the arch, the former may be made to offer the resistance necessary for bringing the latter into alignment.

Fig. 66.

Magill bands are fitted to the centrals, and a bar of half-round platinous gold is soldered to these on their labial surfaces extending a little beyond the region of the laterals. When the appliance is cemented to the centrals each lateral is ligated to the bar, which by its elasticity will cause these teeth to move outward.

Fig. 66 represents the device in position.

Where the laterals are situated outside of the arch line a similar appliance is made with the extensions of the bar resting upon the laterals, as shown in Fig. 67.

Pieces of elastic rubber inserted between the bar and the laterals will gradually force them into position.

If, in the act of moving the laterals inward the centrals should be moved slightly outward, the latter will usually fall back into their former positions at the close of the operation.

Fig. 67.

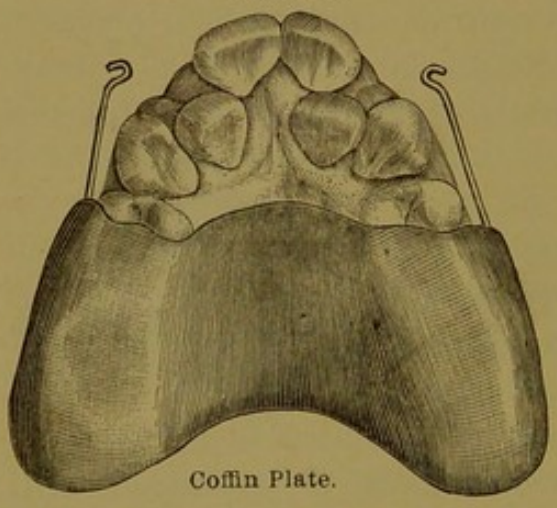
Frequently a better curve of the arch is produced by moving the centrals outward and the laterals inward.

For retaining the moved teeth in their new positions nothing is more effective and simple than a retainer constructed on the "band and bar" principle, as shown in Fig. 29.

Another way of securing the same result is by the use of a Coffin plate and suitably-shaped extension wires, as shown in Fig. 68.

The rubber plate is made to cover the arch and enclose several bicuspids or molars on each side. In each of the buccal portions of the plate a piece of piano-wire is imbedded, which extends forward clear of the teeth and terminates in a curve or hook opposite the tooth to be moved outward. A section of rubber tubing is slipped over the tooth and caught upon the hook. The elasticity of the rubber added to the spring of the metal will rapidly draw the tooth outward provided there is sufficient space in the arch to accommodate it.

Fig. 68.



Coffin Plate.

As already stated, slight spaces existing between the superior incisors when recently erupted need give us no concern provided they are in the normal line of the arch;

but it often happens that in addition to the spacing one or more of them is, to a greater or less extent, turned upon its axis, as shown in Fig. 69.

In other cases the teeth may be in contact, while one of them is turned and overlapping its neighbor, as shown in Fig. 70. In either case it is quite probable that the cutting edge of the turned tooth will occlude with the corresponding surface of the one in the opposite jaw at an angle, and thus either prevent full eruption of one or the other of the teeth, or temporarily open the bite and favor undue elongation of posterior teeth.

FIG. 69.

Torsion with Space.

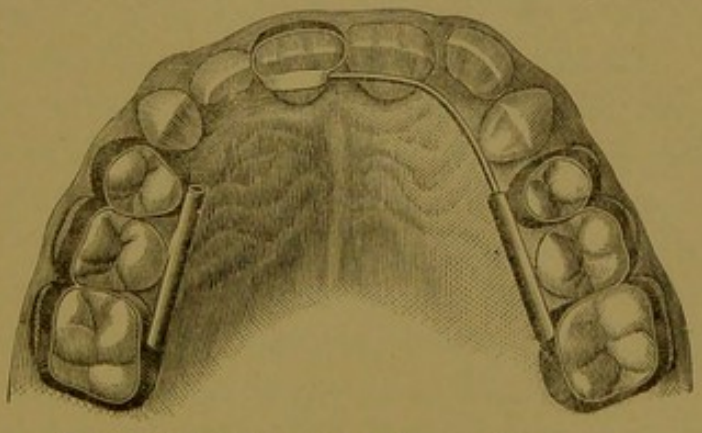
FIG. 70.

Torsion with Overlapping.

Both of these forms of irregularity should receive immediate attention, for at an early age correction is easily accomplished. Were the condition to remain unchanged, it would necessarily become more complicated from partial closure of the space caused by the lateral pressure that would be exerted during the eruption of neighboring teeth.

Rotation of these teeth, as well as of others, may be accomplished by one of the many methods described in Chapter V.

FIG. 71.



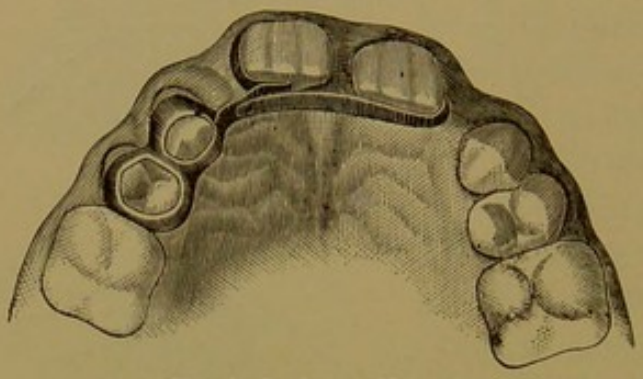
Tube, Band and Spring Appliance. (Matteson.)

Dr. Matteson accomplishes the same result without the employment of a rubber plate. He prefers to band the first deciduous and first permanent molars and joining these bands by a connecting strip on the buccal surface and a piece of round tubing

closed at one end on the palatal surface, as shown in Fig. 71. The incisor to be moved forward has a band of gold or platinum cemented to it, and to this band, on the palatal surface, is soldered a U-shaped lug.

By inserting a piece of fine piano-wire into the tube and springing its free end into the lug on the incisor band the tooth is readily forced into position.

FIG. 72.



Simple Spring. (Matteson.)

Instead of the tube and wire he sometimes employs a thin strip of platinous gold soldered to the bands and made to rest and press against the in-lying tooth, as shown in Fig. 72.

The single appliance may be used to press forward both of the incisors by arranging the strip of spring gold to press upon but one tooth until it is in place, and then altering its form by bending so that it will exert its force upon the other.

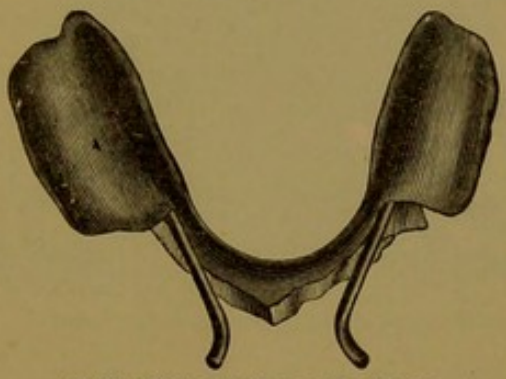
Other appliances of somewhat similar character will readily suggest themselves to an inventive mind.

CHAPTER II.

INCISOR TEETH SITUATED OUTSIDE OR INSIDE OF THE LINE OF THE ARCH AFTER DENTITION IS COMPLETE.

Irregularities of this character will require much the same treatment as similar cases occurring during dentition, but the attendant difficulties will be greater, owing to the increased density of the alveolar structure and the presence of all the teeth, making the obtaining of space more difficult. In the lower jaw, the irregularity in most cases is confined to one or two teeth, standing either anteriorly or posteriorly to the line of the arch. If they are located posteriorly, and the extraction of one of them be not indicated, room should be made (if it does not exist) by pressing apart the neighboring teeth. After this is done, they may conveniently be forced into place by means of a Coffin plate, constructed as shown in Fig. 73.

FIG. 73.



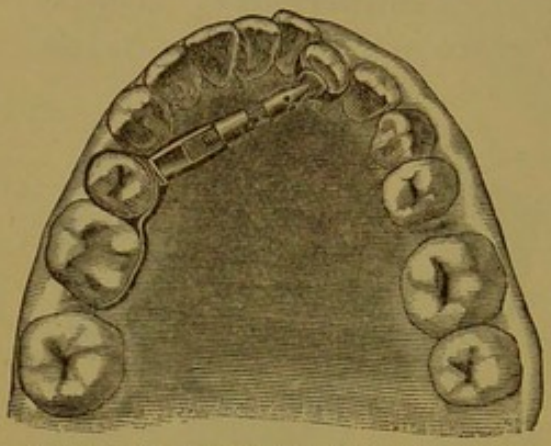
Coffin Plate for Lower Incisors.

When a single lower incisor is locked inside of the arch by the overlapping of its neighbors, it is often so firmly held in its mal-position that all ordinary means will fail to move it unless space is first provided for it by lateral pressure. This being sometimes difficult of accomplishment, the direct power of the screw-jack may be taken advantage of in such cases to overcome the difficulty, as shown in Fig. 74.

A platinum band was constructed to fit the lateral, and on its lingual surface was soldered a tongue of heavy platinum, so formed that it would lie in contact with the tooth

when the band was in position. Into this tongue, near its free end, was drilled a countersunk hole nearly deep enough to pass through the metal. On the opposite side of the mouth the second bicuspid was similarly fitted with a band, to which was soldered a strip of platinous gold long enough to cover the lingual surface of the adjoining molar. By this means the molar was made to assist in resisting the force to be applied to the lateral. The bicuspid band was also reenforced by an additional piece of heavy platinum soldered to it at a point diagonally opposite to the lateral. Into this latter piece a horizontal slot was drilled with an engine-bur, sufficiently deep and long to receive the fish-tail end of an ordinary nickeled-steel screw-jack. After both bands were cemented in place the screw-jack was placed between them, with the flat end in the bicuspid band and the point resting in the countersunk hole of the lateral band. The patient increased the tension of the screw from day to day by turning, and in two weeks' time the tooth was in line. It was held there until it became firm by means of platinum binding wire woven about it and its neighbors.

FIG. 74.



Screw-Jack Forcing Out Inferior Lateral.

In cases where it is not deemed advisable to pursue the plan just mentioned, an excellent way of creating space and at the same time moving an incisor outward into line is by the employment of a double-acting device, composed of a thin metallic ribbon and spring, or bolt and nut.

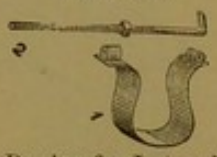
The first recorded suggestion of an appliance of this character appears in one of Dr. Farrar's articles, published in 1884.*

Dental Cosmos, Vol. XXVI., p. 672.

Prof. Angle employs a modified and simplified device, as is shown in the accompanying illustration. It is constructed as follows: The ribbon being of sufficient length to pass back of the inlocked tooth and rest slightly upon the labial surfaces of the adjoining teeth, two short tubes are soldered to it, one at each end. One of these tubes is set vertically and the other horizontally. A piece of steel wire, bent at a right angle at one end and thread-cut and provided with a nut at the other, is made to engage with the tubes, the bent end slipping into the vertical tube and the other passing into the horizontal one, with the nut resting against its inner end. By unscrewing the nut, the ends of the ribbon are forced apart and the desired movements accomplished. Fig. 75 represents the appliance in position, and Fig. 76 the separate parts of which it is constructed. In this device the direct power of the screw is used to furnish the necessary pressure.

FIG. 75.

FIG. 76.

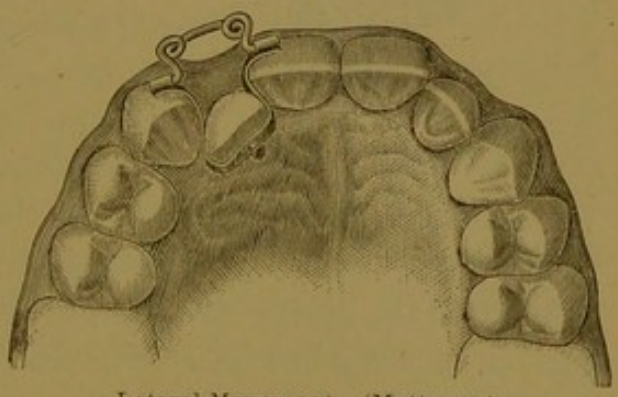


Device for Lateral Movement. (Angle.)

Instead of the nut and bolt, Prof. Matteson prefers a coiled-wire spring to operate upon the ends of the ribbon, as shown in Fig. 77.

The spring is made from piano-wire, No. 14 or 16, and when in place the ends rest in two short tubes soldered horizontally to the ribbon near its extremities. The tubes have slots cut into their upper surfaces to prevent the spring from pressing upon the gum.

FIG. 77.



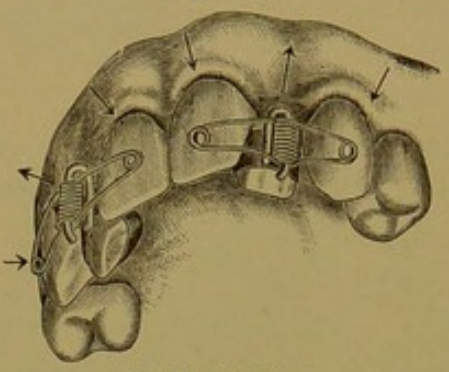
Lateral Movement. (Matteson.)

Should the tension of the spring not be sufficient to move the tooth entirely into place, a longer one may be substituted for it.

As will be noticed, the ribbon has a short-headed pin or post soldered to its exposed surface opposite the centre of the inlocked tooth to furnish a ready means of ligating the band to the tooth should it be necessary to prevent its slipping out of position.

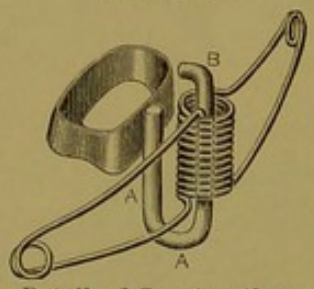
Another appliance for drawing outward an instanding incisor is known as Siegfried's Regulating Spring.* It is shown in position in Fig. 78 and separate in Fig. 79.

FIG. 78.



Siegfried Spring.

FIG. 79.



Detail of Construction.

The spring is fashioned from hard-drawn German silver, platinous gold or piano-wire. It consists of a central coil with a wing extending on each side. When in repose these two wings lie against one another. The tooth to be removed is fitted with a Magill band, to the buccal side of which is soldered a stiff wire bent in the form of a U with one arm slightly longer than the other.

After the band is cemented to the tooth the wings of the spring are opened, the coil slipped over the U wire with the wings pressing upon the adjoining teeth. To prevent the spring from slipping off the longer arm of the U wire is bent over after the spring is in position. The constant tension of the spring will tend to move the tooth outward into line, the arrows in Fig. 78 showing the direction of the forces.

When an incisor tooth in the lower jaw stands outside of the arch, the malposition is usually due either to its having been forced out of place by a superior one occluding back of it, or to unusual crowding on the part of its neighbors. In the first instance, the correction of the occlusion of the

*_Dental Cosmos_, June, '96, p.——

superior tooth will usually press the lower one into its proper place, while in the second instance, it will be necessary to consider the advisability of extracting one of the crowded teeth to afford room. If such extraction be deemed best the case will be greatly simplified and the malposed tooth can be brought into line by some one of the means described for drawing inward the superior incisors.

If it be deemed inexpedient to extract one of the crowded teeth, room will have to be provided either by expanding the arch or by extracting a tooth or teeth back of the cuspids.

In considering the matter of expansion of the arch it should be borne in mind that the enlargement of one arch may also necessitate the expansion of the other in order to preserve the normal occlusion. If both jaws will admit of it to advantage, it may be the best plan to pursue, although it will necessarily increase the labor and difficulty of the operation. Generally, if the occlusion and facial expression be satisfactory, it will be far better not to disturb the general relation of the teeth, but rather to extract one or more of the bicuspids or molars. After any of the posterior teeth have been extracted, the anterior ones can be moved apart or backward and the irregular tooth brought into place.

The inferior incisors, after being brought into line, will usually be retained in place by the occlusion of the superior teeth, but where this is not the case, they may be retained by means of platinum binding wire woven about all of the incisors at or near their necks, or they may be securely held by means of a ribbon of thin gold fitting the lingual surfaces of the incisors, to which is soldered a platinum band to encircle each tooth that has been corrected. The piece is set with phosphate of zinc as a lining to the bands.

For drawing or forcing into line any of the superior incisors standing outside of the arch, a variety of methods is at our disposal. In the upper jaw the extraction of one or more incisors to provide room for other outstanding ones is, except in rare cases, not to be thought of, although, as just stated, in the lower jaw extraction may often be advantage-

ously resorted to. The greater conspicuousness of the superior incisors, and the difference in size between the centrals and laterals would cause the absence of any one of them to be most noticeable. Rare cases occur, however, in which such extraction is justifiable, as already described, but a wise discrimination must be exercised in regard to the matter, as otherwise a greater deformity is likely to be created than the one already existing. Where space is needed in the arch for the outstanding tooth or teeth and expansion of the arch is not indicated, we may obtain it by extraction back of the cuspids, or where the lack of space is slight in amount it may be secured by simply exerting pressure upon the adjoining anterior teeth. A simple way of producing this pressure is by the use of compressed wood, as described on page 82.

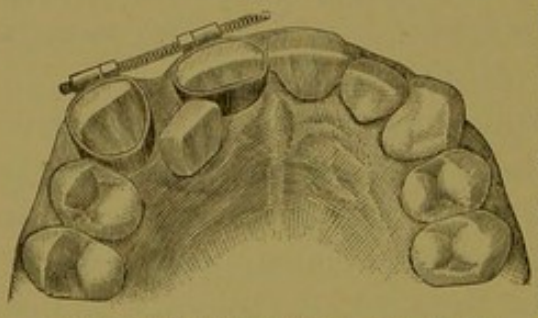
Another plan is by means of a vulcanite plate to which are attached gold or steel wires so arranged that their free ends when drawn together and inserted in the space intended to be widened, will press the adjoining teeth farther apart.

Still another, without the use of a plate, which the author has found very effective, consisting of platinum bands attached to the teeth to be moved, with a piano-wire spring acting between them, is described and illustrated in Part III., chapter VI.

Dr. Farrar recommends for the same purpose a delicate screw-jack with crutch ends to fit the teeth to be separated.

Prof. Goddard employs for the same purpose an appliance, as shown in Fig. 80, and constructed as follows:—

FIG. 80.



Appliance for Separation. (Goddard.)

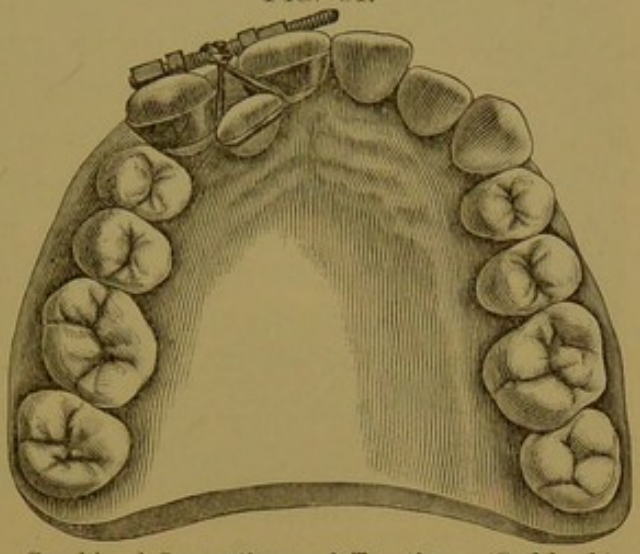
The two teeth bordering the space are encircled by bands having short open tubes soldered to their labial surfaces in a horizontal position. Through these tubes is passed a threaded wire having two nuts upon it. One of these is designed to

simply offer resistance, while the other, by being turned, will gradually force the teeth apart.

After the desired space has been obtained, the inlocked tooth may be brought into place by any method preferred.

Prof. Goddard has recently improved his screw and band appliance by looping a rubber ring over the screw and passing it over the lateral, as shown in Fig. 81. By this simple arrangement the lateral is moved outward at the same time that the central and cuspid are being forced apart.

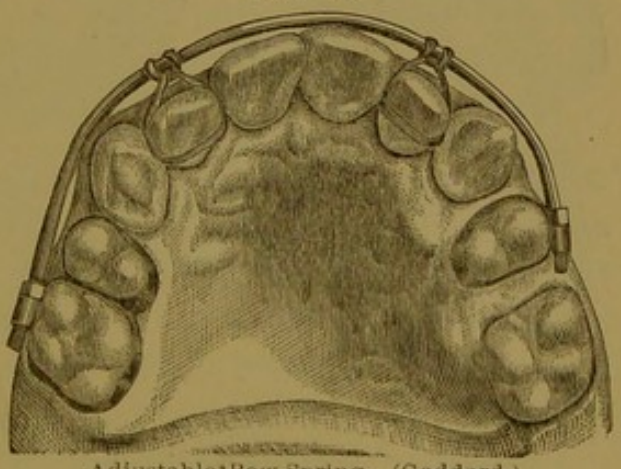
Fig. 81.



Combined Separation and Traction. (Goddard.)

In devising appliances for moving the superior incisor teeth either inward or outward into line, due consideration must be given to the occlusion. To avoid conspicuousness, it is desirable to have the operating appliances placed within the arch, but very frequently the occlusion of the lower teeth will interfere with such arrangement. In the latter case they may be so constructed as to operate from the outside.

Fig. 82.



Adjustable Bow-Spring. (Goddard.)

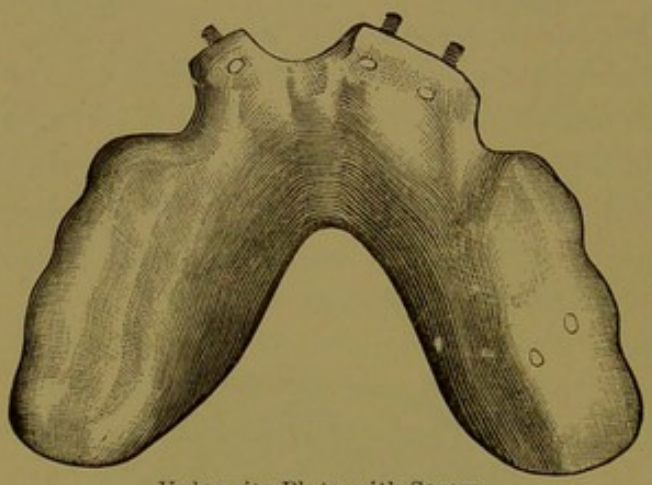
Fig. 82 shows a common form of band and bow-spring arrangement in which the instanding incisors are operated upon by rubber bands looped over the bow-spring. When the teeth approach the wire the arch is enlarged by means of the nuts operating against the tubes on the bands.

One of the simplest methods for moving one or more incisors outward into line is by the employment of the Coffin solid plate, as shown in Fig. 53. The only difficulty met with by the author in the use of this form of plate has been where the teeth to be moved, although inside of the arch, stand perpendicularly or incline slightly forward. In these cases the free ends of the wires, after being pressed up into position on the teeth, are frequently thrown down toward the cutting edge by the force of the spring operating upon an inclined surface. When great inconvenience arises from this cause, it may be remedied by cementing a narrow platinum band about midway of the crown of the tooth to be moved, and placing the end of the wire spring above it.

Another plan for moving outward any or all of the superior incisors, is by means of a plate constructed as shown in Fig. 83.

A thin vulcanite plate is made to cover the roof of the mouth and cap the bicuspids and molars; opposite the tooth or teeth to be moved the plate is allowed to come nearly down to their cutting edges. Directly opposite the center of each of these teeth a hole is drilled entirely through the rubber to receive a piece of screw wire long enough to pass through and project a little beyond the plate. In springing the plate into position the slightly projecting ends of the screws will press against the teeth and they will be moved forward. A half turn of the screws every day will soon force the teeth into position.

FIG. 83.



Vulcanite Plate with Screws.

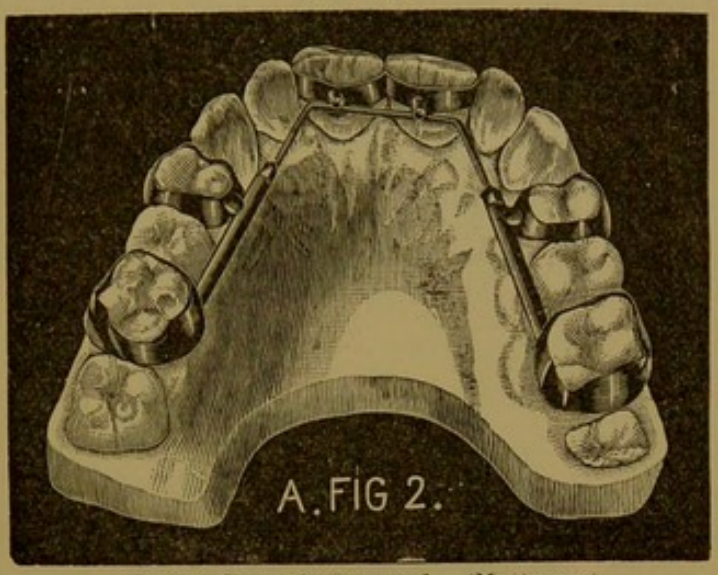
Dr. Dodge* suggests the employment of a hollow metal

Dental Cosmos, Vol. XXXI., p. 772.

screw tipped with gutta-percha at its exposed end used in connection with a vulcanite plate, as just described, claiming for it greater friction in contact with the tooth and non-liability to injury of tooth substance.

Less cumbersome than rubber plates and more positive and satisfactory in the majority of cases are appliances constructed entirely of metal.

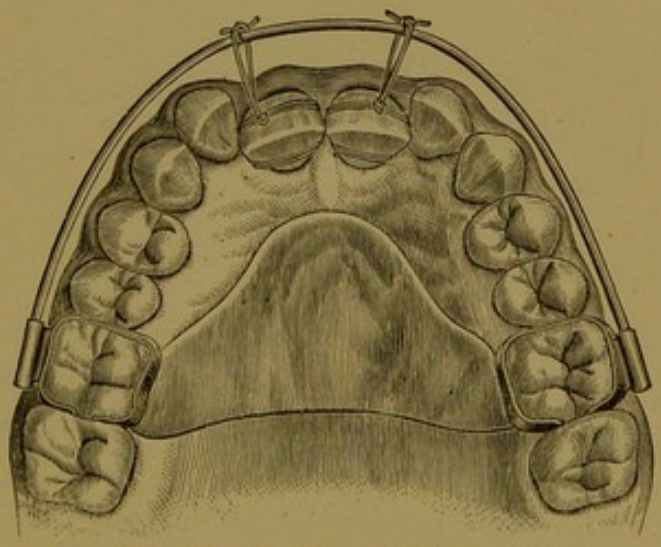
FIG. 84.



Moving Centrals Outward. (Matteson.)

Fig. 84 shows one of this character designed by Prof. Matteson,* somewhat on the Angle plan, for the purpose of moving forward two inlocked superior central incisors. As will be seen, it is firmly attached to the anchor teeth by cemented bands and is operated by turning the nuts which rest against tubes soldered to the anchor bands.

FIG. 85.



Plate, Band and Bar Appliance. (Kirk.)

Should the occlusion not permit the use of the appliance just described, the same end may be attained by employing a fixture devised by Dr. Kirk† and illustrated in Fig. 85.

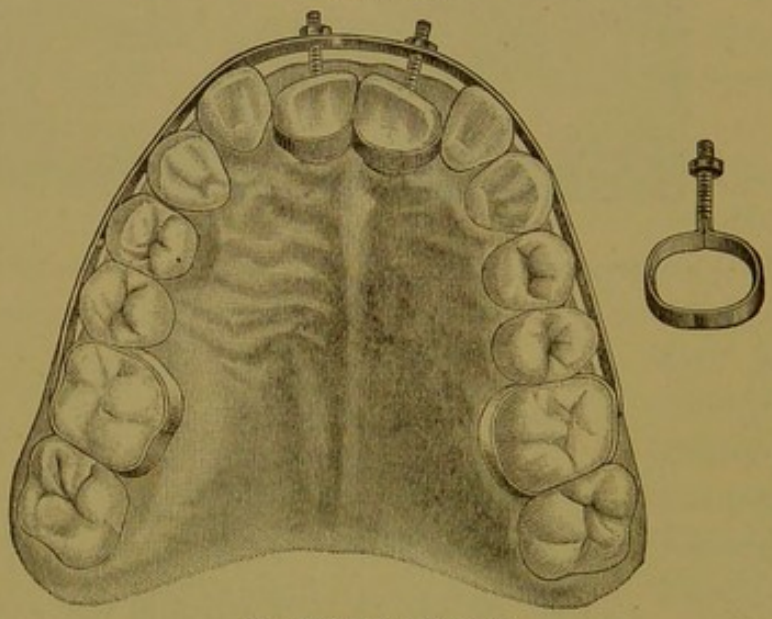
*_Dental Review_, July, '92, p. 564.
†_Dental Cosmos_, Vol. XXXIII., p. 908.

It consists of a narrow silver plate swaged to fit and partly cover the roof of the mouth, to which are attached two broad clasps of platinized gold fitting the first molars. To the buccal surfaces of these clasps are soldered tubes closed at their distal ends to receive a gilded piano-wire, bent to conform to the outline of the arch, but slightly longer.

When in position, the inlocked centrals are tightly ligated to the wire immediately in front of them, which by its elasticity draws them forward.

An appliance differing somewhat from the one just described is that of Dr. Bedell,* shown in Fig. 86. In this case the bow-spring is made of flattened German silver wire,

FIG. 86.



Dr. Bedell's Appliance.

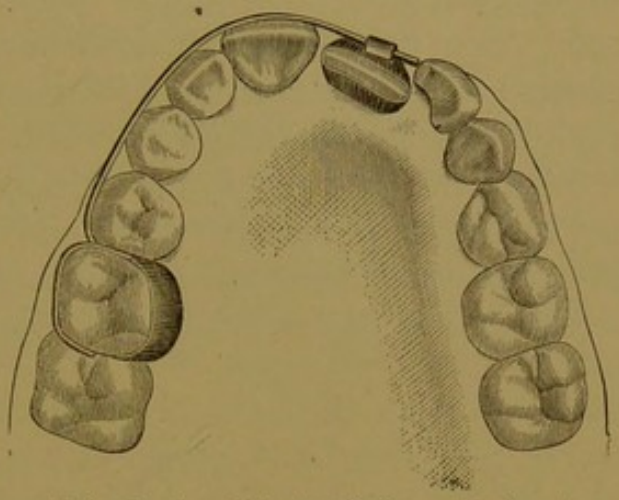
which, after being bent into the form of an ideal arch has its ends soldered to bands that encircle the first molars. The bands that are fitted to the teeth to be moved have a threaded wire attached to the center of their labial surfaces. These wires or screws pass through holes drilled in the bow-wire after which nuts are run down upon them. Turning the nuts bends the bow-wire inward and it in turn by its elasticity tends to draw the teeth outward. As the teeth move the projecting wires are ground off close to the nuts to prevent irritating the lip.

Items of Interest, Aug., '97, p. 599.

Another appliance, simple in construction and not interfering with occlusion, designed to draw one central outward into line and at the same time press the adjoining prominent one back into place, is shown in Fig. 87.

It was devised by Dr. Jackson and is constructed after his method. The first molar is fitted with a crib to which the extending spring-wire is attached. This engages at its free end with a tubed band cemented to the inlying central, and in its course rests upon and presses against the prominent central. A double movement is thus produced and the power of the spring may be increased as desired by straightening its curve.

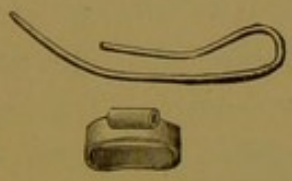
FIG. 87.

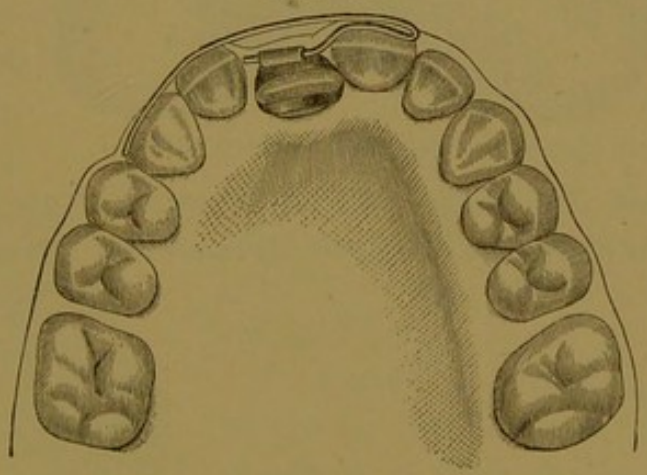


Crib, Band and Spring Device. (Jackson.)

Still another device, even more simple than the preceding one, for moving forward an inlocked incisor, is illustrated in Fig. 88.

FIG. 88.





Tubed-Band and Spring. (Jackson.)

It also is one of Dr. Jackson's, and consists simply of a tubed-band attached to the malposed tooth and an ingeniously arranged wire spring to furnish the motive power.

The spring is formed by bending a piece of piano-wire

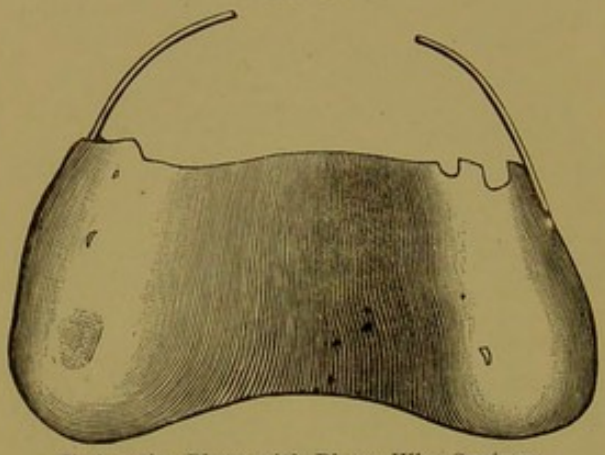
into the form of a loop with one end much longer than the other and both of them suitably curved to follow the outline of the arch. The longer arm of the spring should at least be long enough to cover the surfaces of three teeth to furnish proper support.

In adjusting the spring, the longer arm should be next to the gum while the shorter one is being inserted into the tube, then by turning it downward the whole appliance comes into proper position with the shorter arm acting as a spring to draw the incisor outward.

When the tooth is in place it may be retained by inserting a short wire into the tube and allowing it to rest upon the labial surfaces of the two adjacent teeth.

Where any one or two of the superior incisors stand outside and there is a space for their accommodation in the arch they can very easily be moved into place by means of a plate as shown in Fig. 89.

FIG. 89.



Vulcanite Plate with Piano-Wire Springs.

The plate is of vulcanite in which two piano-wire springs are imbedded. These spings are arranged to rest and bear upon the outstanding teeth and may be bent from time to time to increase the tension.

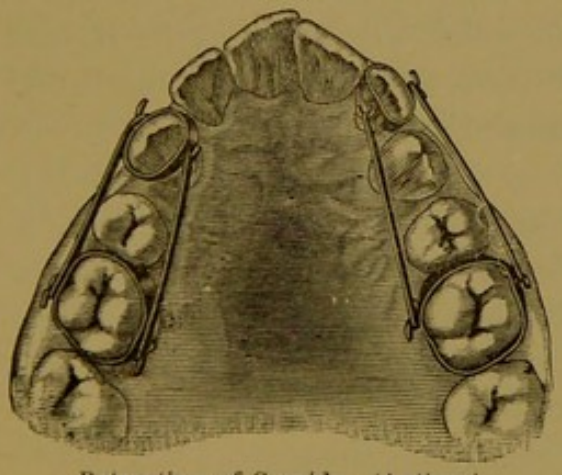
CHAPTER III.

CUSPID TEETH SITUATED OUTSIDE OR INSIDE OF THE ARCH.

Delayed or Maleruption of Cuspids.

The third molars excepted, the superior cupids are usually the last teeth of the permanent set to erupt, and they almost invariably make their appearance outside of the arch. When there is room in the arch for their accommodation and they erupt directly outside of it, we may feel assured that in due time they will find their way into place unaided. Where, however, they erupt over the lateral incisors, as is sometimes the case, and these incisors are in consequence being forced inward, it becomes necessary for us to interfere and endeavor to draw the cuspids toward their proper places. This is usually not a difficult matter when the cuspid crown is far enough erupted to enable us to exert pressure upon it. In such a case, by cementing a Magill band to the cuspid and another to the second bicuspid or first molar, each having a pin or hook attached to its buccal surface, a rubber ring extending from hook to hook will in a short time draw the cuspid back to a position opposite the space it is to occupy, as illustrated in Fig. 90.

FIG. 90.



Retraction of Cuspids. (Author.)

It sometimes happens, however, that the cuspids are tardy in their eruption and fail to assume their positions in the arch at the time they are needed to

complete the row and prevent the incisors and bicuspids from encroaching upon the space the cuspids are to occupy. In such cases it is generally advisable to hasten their eruption by the application of tractile force in some manner. Where one-half of the crown is through the gum we can attach to it a Magill band with a pin, hook or other projection upon it, and by its assistance readily apply power to the tooth.

The author has had several cases where extrusion of the cuspid was called for, when only the cusp of the tooth was visible through the gum. Here the application of a cemented band was out of the question, and attachment to the tooth had to be gained in another way. The difficulty was solved by tying a silk ligature in a half knot, passing it over the projecting cusp, and then with a small, flat plugger, forcing this ligature up under both gum and alveolus until it encircled the neck of the tooth, when it was drawn tight and made fast with a surgeon's knot. A very small gold ring, with a center only large enough to admit of the passage of silk floss, was then slipped over one of the ends of the ligature and tied so that it would lie upon the labial face of the tooth near the gum. This ring was allowed to remain without change until the tooth was drawn into position. A delicate vulcanite plate was constructed to fit the arch, and extend into the space between the lateral and first bicuspid. At this latter point the plate was thickened until it was nearly on a level with the occlusal surfaces of the adjoining teeth, and made concave on its most prominent part. A rubber spur was also formed on the plate, in a line with the cuspid and space. The plate being in position, a rubber band was passed over the spur and drawn tight to the ring on the tooth by means of a ligature, the band in its course resting in the notch of the elevation on the plate. By this arrangement no pain was inflicted except that incident to forcing the ligature into position under the gum, while power

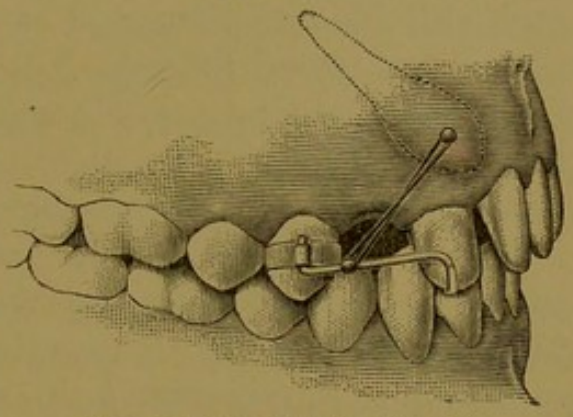
was exerted in a nearly direct line with the long axis of the tooth, and in a gentle, continuous manner.

Another and most excellent plan of securing attachment to a partially erupted cuspid, is that recommended by Prof. J. F. Flagg. It consists in screwing a gold ring-bolt or screw-eye into the point of the cusp. The screw-eye is made by soldering a small gold ring to a piece of gold screw-wire. After the correction is accomplished, the screw is removed and the hole filled with gold.

A very simple and effective appliance, securely attached to the teeth, for drawing a cuspid down into position has been devised by Dr. Angle, and is shown in Fig. 91.

As will be seen, the bicuspid is fitted with a metal band to which is soldered a short piece of tubing. A wire of suitable length is flattened at one end and bent into a hook to engage with the cutting edge of the lateral, while the other end is bent at a right angle to fit into the tube on the bicuspid band. Midway of the length of this wire is soldered a small button. The unerupted cuspid has a headed pin cemented into its labial surface or point of cusp, and over this pin and the button on the wire is stretched a section of rubber tubing to produce the desired tension.

FIG. 91.



Drawing Down Cuspid. (Angle.)

If malposition of an erupting cuspid should be complicated with more or less torsion, the correction of the latter will be best accomplished after the tooth is nearly or quite in position.

Cuspid Teeth Situated Outside or Inside of the Arch.

Of the various forms of irregularity that present for treatment, none perhaps is more common than that in which the cuspid teeth are located outside of the arch. The cause most frequently responsible for this condition is the premature extraction of the temporary cuspids, although it is often caused by delayed eruption of the permanent ones, and by the lack of accommodation a small arch sometimes affords for the full complement of teeth. The cuspids (superior) being among the later teeth to appear, often find their territory pre-occupied by the earlier arrivals. Frequently, though not always the malposition of the cuspids is associated with like malposition of certain neighbors, usually the central and lateral incisors. The irregularity of these adjoining teeth is, in most cases, brought about by the pressure of the cuspids in their attempt to occupy their places; for previous to their appearance there is no inducement, if the occlusion be normal, for the incisors to vary much from their true positions. The fact should not be overlooked that all teeth in erupting are impelled by a strong hidden force to seek their proper positions in the line of the arch, and in no teeth is this persistence more plainly or powerfully exhibited than in the cuspids.

The conditions being favorable each tooth will naturally assume its place in line, and should obstructions interfere it will strive to overcome them; but the cuspid teeth will, if necessary, exert a power far exceeding that of any of the other teeth in their efforts to gain their proper positions in the arch. To this end incisors are often disarranged, and bicuspids forced inward or outward. This wonderful force exerted by the cuspids, may well be illustrated by a case which occurred in the practice of the author many years ago:

The patient was a young lady about fifteen years of age, in whose upper jaw a cuspid had erupted outside of the arch, causing projection of the lip. All of the other teeth were regular, but the bicuspids and molars on the affected side were somewhat in advance of their true positions, and there was consequently very little space in the arch for the accommodation of this cuspid. The first molar on the same side was badly decayed, so it was decided to extract it preliminary to making room for the cuspid. An appliance was then attached to the second molar and second bicuspid, intended to draw the latter tooth backward. The patient left with this fixture in position and did not return until eighteen months later, when it was noticed that both bicuspids had moved backward and the cuspid occupied its normal position in the arch. It transpired that the appliance, having caused some pain, was removed by the patient two days after it had been placed in position. The correction of the irregularity had been entirely accomplished by the cuspid forcing its way into place and crowding the bicuspids backward in the effort.

To obtain space for the accommodation of the cuspid when it is situated outside of the arch, we usually have to decide between the enlargement of the arch and the extraction of a tooth anterior or posterior to it. If the upper arch is contracted and will admit of expansion to advantage, it may be done by one of the methods described in Chapter VI. of this part; but if this be not indicated, we will have to decide upon the extraction of a bicuspid or lateral in order to obtain space.

A careful consideration of the rules governing extraction, Part I., Chapter VI., will greatly assist the operator in deciding which tooth to extract.

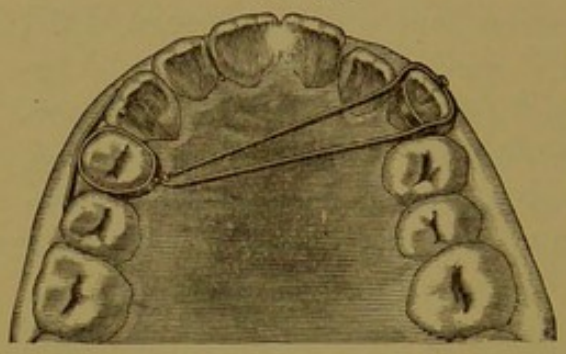
It very frequently happens that the space in the arch intended to accommodate the cuspid is nearly, but not quite, sufficient. In such cases, slight additional space may gen-

erally be gained by pressing apart the adjoining teeth by one of the methods shown in Part III., Chapter VI.

Room having been provided, the cuspid tooth may be brought into place by one of several methods that are equally effective in the upper and lower jaws. Outstanding cuspids are usually situated a little in advance of their normal positions, so that in bringing them to place we must exert force in a backward as well as inward direction.

Where from the appearance of the teeth and surrounding parts it seems probable that great force will not be required, a cuspid may frequently be drawn inward by so simple a means as that shown in Fig. 92.

Fig. 92.



Metal Bands and Rubber Ring.

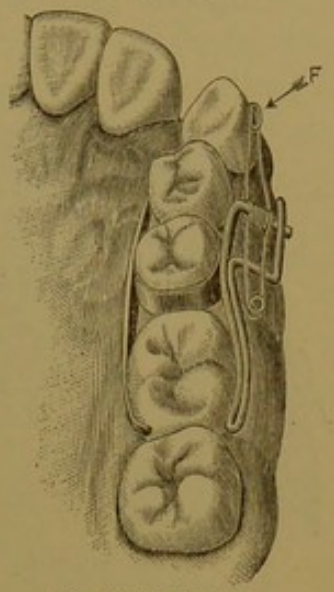
In this case a platinum band, with a pin on its labial face, was cemented to the outstanding cuspid. To the first bicuspid on the opposite side was fitted a similar band with a small gold hook on the palatal surface and a bar of platinous gold on the buccal surface long enough to extend to and rest upon the adjoining cuspid and second bicuspid. This provided the resistance of three teeth, while attachment was made to but one. A thin vulcanite plate was made to cover the arch so as to protect it from the irritation of the rubber ring, which was stretched from band to band. The operation of bringing the tooth into line was somewhat slow, occupying some four or five weeks' time, but the object was satisfactorily accomplished.

For moving a single cuspid inward into line, where space exists for its accommodation, a modified Siegfried spring may be employed as shown in Fig. 93.

In this case but one wing of the spring is used for the

application of force, the other resting upon a wire framework which extends to and lies against some posterior tooth.

Fig. 93.



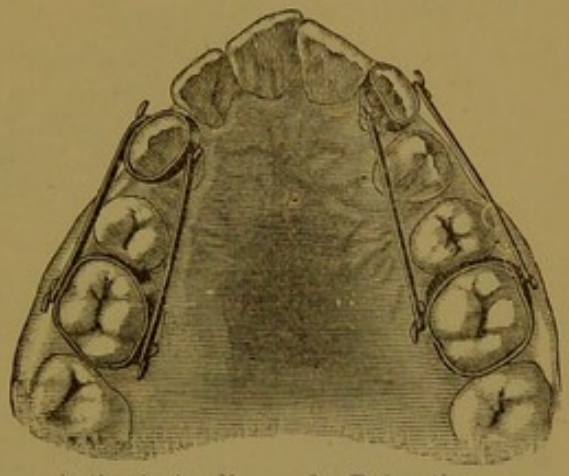
Siegfried Spring.

The banded tooth is kept from moving by having attached to it a piece of stiff metal which impinges upon the two adjoining teeth.

Where the movement to be effected is more backward than inward, it may often be very satisfactorily and easily accomplished by the simple appliance shown in Fig. 94.

A platinum band, with short gold wires soldered to the buccal and lingual surfaces, is cemented to the tooth to be moved, while a similar one is attached to a molar or other anchor tooth. The wires on the anterior band are bent forward, and those on the posterior one are curved backward. Two rubber rings, caught over the gold hooks, connect the two bands and yield the tractile power required. These rubber rings can be removed and replaced for cleansing the teeth, or can be renewed at will by the patient. Two rings can be attached to each pair of hooks, if greater power be required, or the same object can be attained by cutting wider rings from thicker tubing.

Fig. 94.



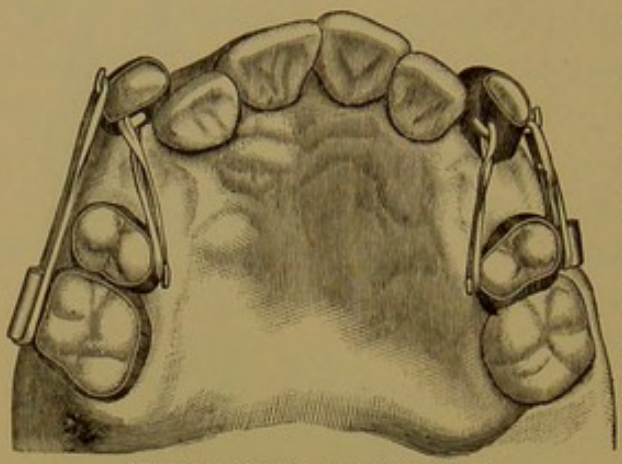
Author's Appliance for Retraction.

Prof. Goddard has modified the author's appliance by using tubes on the buccal surfaces of the molar bands instead of hooks. These tubes can subsequently be used for

accommodating a bow-wire with which to draw out any of the instanding incisors. (See Fig. 95.)

Another simple way of bringing about the same movement, is by the use of a Coffin plate with the wire or wires attached to the buccal portion and extending forward until their free ends rest upon the teeth to be moved. Ordinarily, the pressure to be exerted by them would be inward only; but by bending their ends into the form of partial hooks, so as to engage with the mesial surfaces of the teeth, an additional backward pressure is obtained. (See Fig. 89.)

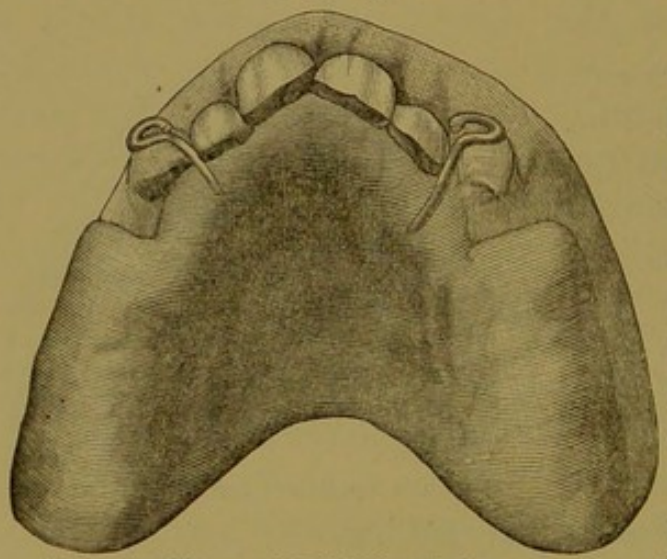
FIG. 95.



Modification by Prof. Goddard.

Fig. 96 represents a vulcanite plate with platinous gold springs for pressing backward the superior cuspids, as employed by Dr. Kells.* By repeated bending of the springs from day to day the cuspids may be rapidly pushed back into the spaces created by the extraction of the first bicuspids. The plate is rather cumbersome but it is a simple and inexpensive method of accomplishing the desired result.

FIG. 96.



Vulcanite Plate and Gold Wire Springs. (Kells.)

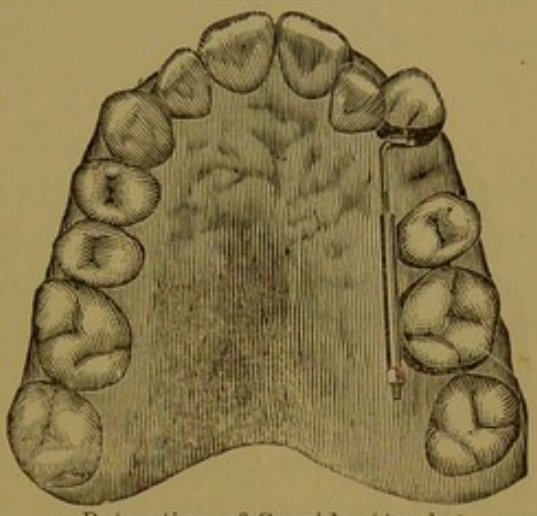
Items of Interest, Jan., '97, p. 50.

In most cases, however, greater force than that exerted by a rubber band or spring wire will be necessary to draw a cuspid into place, especially if it be large and firmly implanted. In such event the power exerted by a screw in some form will probably yield the best results.

One of the simplest and best appliances for drawing a cuspid backward and inward into line is that devised by Prof. Angle and shown in Fig. 97.

The first molar is encircled by a metal band, to which on its palatal surface is soldered a long piece of tubing to accommodate the traction screw.

FIG. 97.



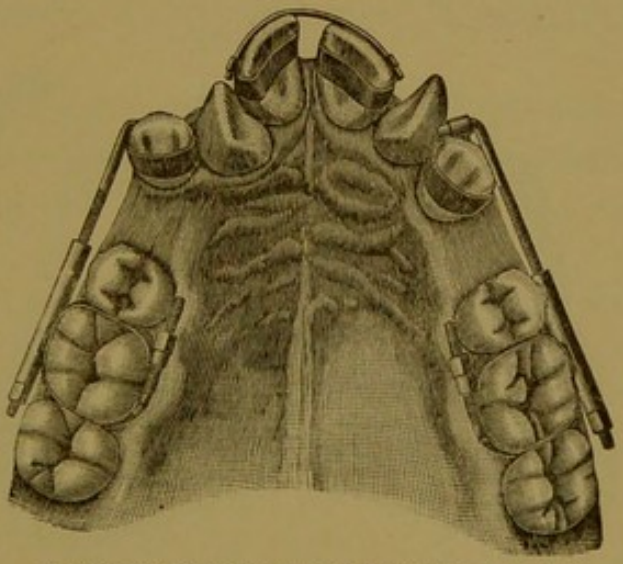
Retraction of Cuspid. (Angle.)

The cuspid is also encircled by a band with a short tube soldered horizontally to it on its distal surface with which the bent end of the traction screw engages.

The nut operating against the distal end of the long tube will rapidly move the cuspid into position.

Fig. 98 illustrates another appliance of Prof. Angle's, very similar in character, but with the tube and screw located upon the outside of the arch.

FIG. 98.



Backward Movement and Rotation. (Angle.)

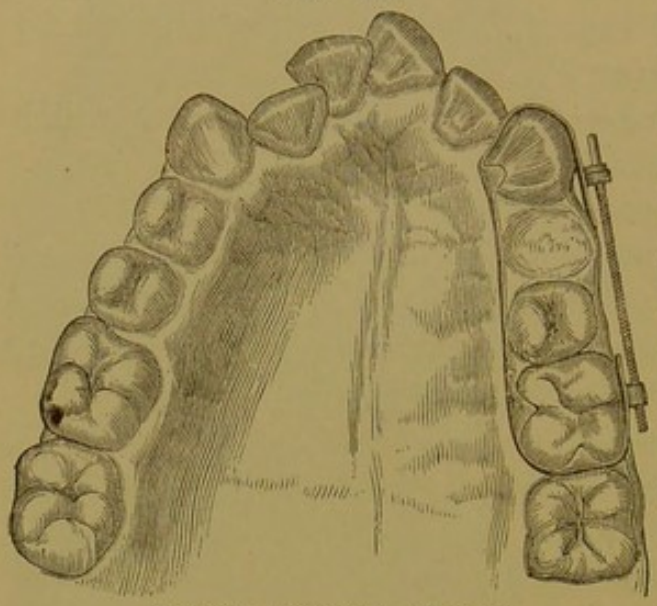
It will be noticed that on the left side the short pipe or tube is attached to the cuspid band at the mesio-buccal angle of the tooth in order to rotate it as well as draw it backward, while upon the right side the screw is hooked

over a spur upon the cuspid band to accomplish the same purpose more conveniently.

Dr. Farrar's device for effecting the same movement is shown in Fig. 99.

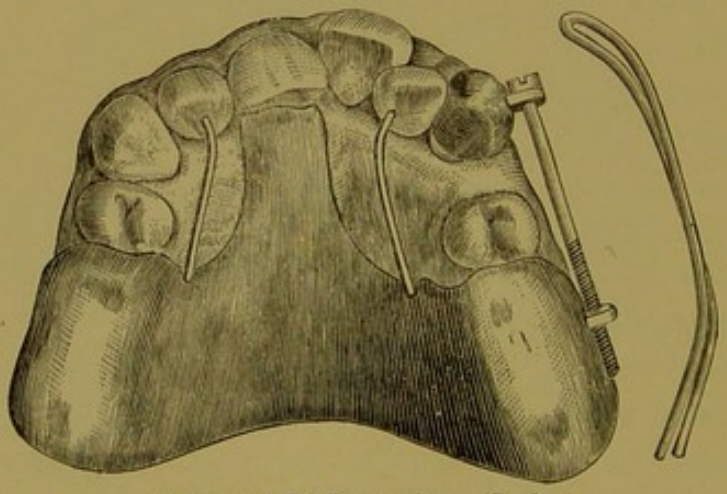
It consists of a narrow ribbon of gold, long enough to enclose the cuspid tooth and some tooth back of the space it is to occupy. The ends of this ribbon nearly meet on the buccal side of the teeth, and after being reënforced with studs of heavy gold, the anterior one being simply drilled and the posterior one drilled and threaded, they are connected by means of a gold screw. The turning of the screw brings the ribbon ends nearer together, and causes corresponding traction on the misplaced tooth. The ribbon, at suitable places, has ears or tips attached to it, intended to rest upon the masticating or inclined surfaces of the enclosed teeth and prevent the band from slipping up and irritating the gum.

Fig. 99.



Traction Apparatus. (Farrar.)

Fig. 100.



Appliance for Retraction. (Darby.)

Prof. E. T. Darby's plan for

producing the same movement is by the use of a rubber plate, a gold encasement for the cuspid and a gold screw for connecting the two and producing the required tension. Fig. 100 is drawn from one of his models, and represents the fixture in position. The case was that of a young lady, fourteen years of age, who applied for the correction of irregularity of the anterior teeth. As will be noticed in the illustration, both laterals and the right central were inside the proper line of the arch, while the left central was outside of it. Space was needed to bring these teeth into position, and to obtain it the left cuspid had to be moved backward in the arch. Opportunity for so doing was afforded by the absence of the first bicuspid.

To move the cuspid backward, and to assist in accomplishing other movements, a rubber plate covering the arch and capping the molar teeth was constructed, and into it on the buccal surface was inserted a gold stud or ear, drilled and tapped. A gold helmet to cover the entire crown of the cuspid was then constructed, with a projection on the labial surface drilled for the passage of the traction screw. After this helmet was cemented in place with phosphate of zinc, and the plate inserted, the two were connected by means of a long gold screw. Twice each day this screw was turned, until the cuspid was brought almost into contact with the second bicuspid.

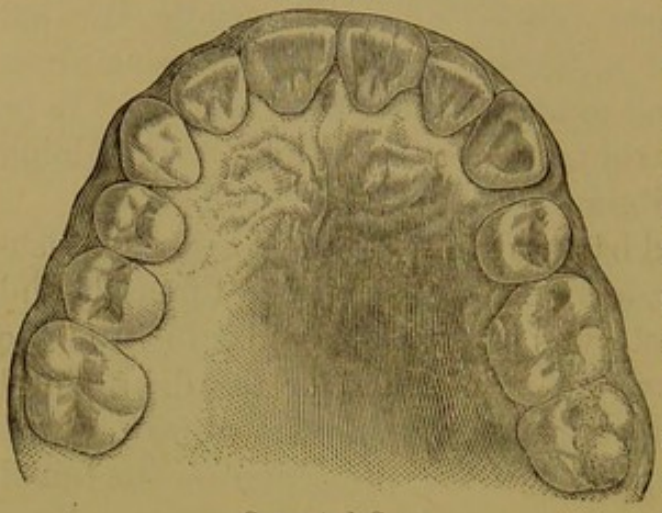
While this movement was progressing, other objects were being accomplished. The rubber plate when first inserted had a piano-wire spring attached to its palatal surface to force forward the right central. This accomplished, the spring was removed and rubber added to the plate to keep this tooth in its new position. Two new piano-wire springs were next inserted to spread apart and press forward the laterals, as shown in cut. They were brought into position by the time the cuspid had been drawn sufficiently backward.

The helmet and screw were now removed and a piece of

piano-wire, doubled and bent to proper shape, was inserted in the hole of the gold stud in the rubber plate, in such a way that the end would rest upon the outstanding central and force it into line.

The case as corrected is shown in Fig. 101. The entire work of correction, with its varied movements, occupied but five month's time, and was accomplished by the use of a single plate with its different attachments. To retain the teeth in position a rubber plate was worn covering the arch and having a gold T inserted to pass between the centrals.

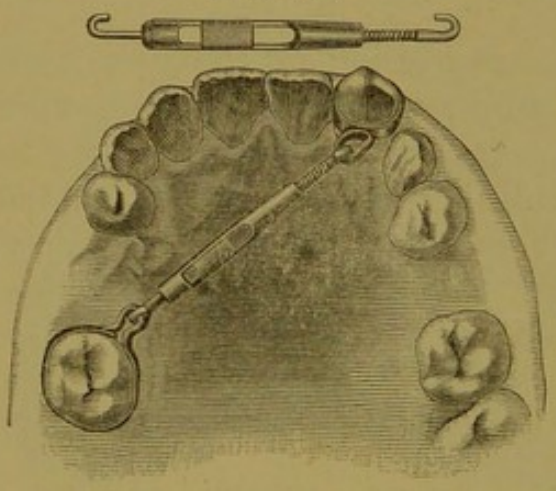
FIG. 101.



Corrected Case.

Where the occlusion of the teeth would not contra-indicate its employment, an outstanding cuspid may be drawn inward by means of a screw operating between the tooth to be moved and those used as anchorages.

FIG. 102.

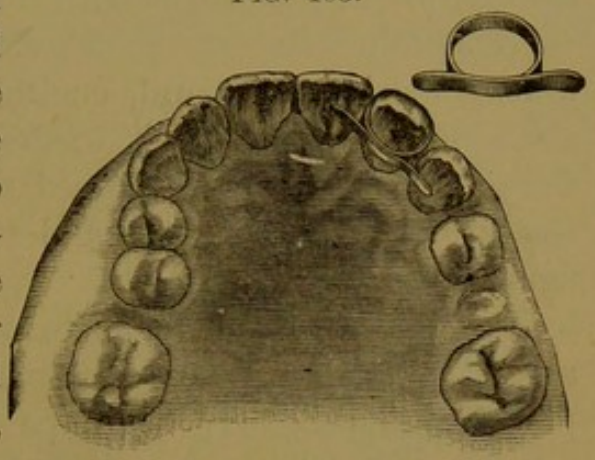


Gold Box and Screw Drawing in Cuspid.

Fig. 102 represents a case of this character, where, in addition to the firmness of the tooth, the patient resided at such a distance from the dentist that a visit to him could be made only at intervals of two or three weeks. It was therefore necessary to devise an appliance of such character that it could not be removed or

misplaced, and with a sufficiency of power that might be regulated by the patient herself. The appliance shown in cut, consists of two platinum bands made to fit the misplaced cuspid and opposite molar respectively, and cemented to these teeth. To the palatal surface of each of these bands was soldered a gold ring, which served as point of attachment for the gold box and screw, which operated between them.

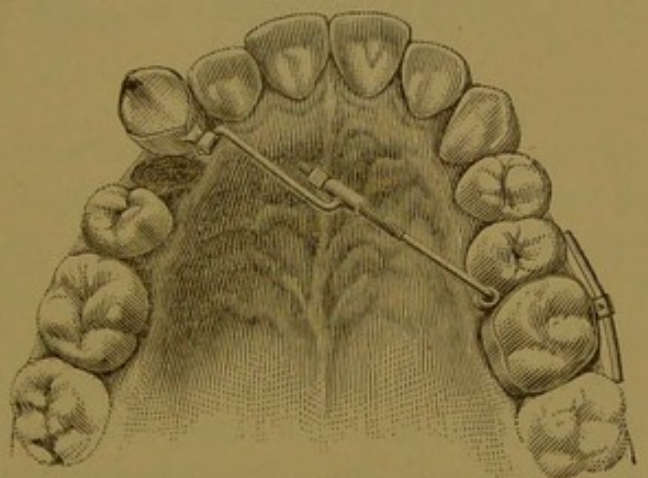
FIG. 103.



Completed Case with Retaining Appliance.

One end of the gold box was bushed and thread-cut to receive the gold screw, which at the opposite end was bent into the form of a hook to engage with the ring on the cuspid band. The other end of the box was fitted with a smooth gold wire, with a head on one end to serve as a swivel, and a hook on the other to attach to the ring on the molar band. Turning the box with a wrench drew the screw inward, and with it the cuspid tooth. Using a single molar for anchorage in the movement of a cuspid was scarcely in accord with correct practice, but in this case there was no alternative. In drawing the cuspid to place, the molar was also moved somewhat inward and forward, but it soon resumed its former position after being relieved from duty. The corrected tooth was retained in place by having cemented to it the small band and bar appliance shown in position and separately in Fig. 103.

FIG. 104.



Combination Appliance for Drawing in Cuspid. (Angle.)

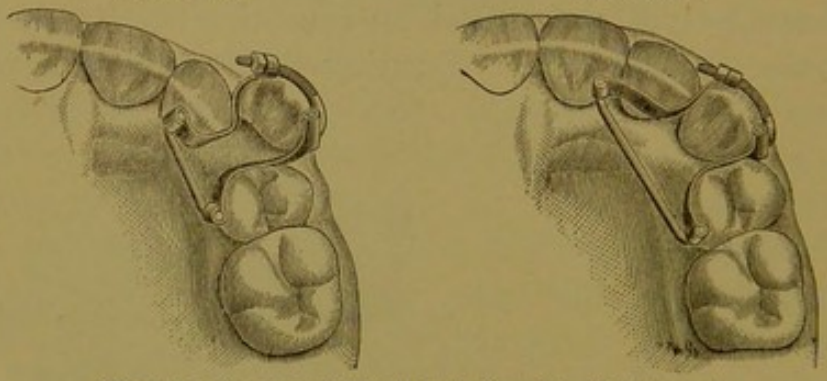
Another appliance of the same general character, but different in construction, and designed by Prof. Angle, is illustrated in Fig. 104. It is described as follows:—

"The cuspid tooth is banded and a piece of gold wire, bent sharply at right angles, is hooked into a pipe soldered to the surface. The other end of the wire is soldered to a pipe through which the small traction screw is slipped, and against which the nut works.

"The other end of the traction screw is hooked into a pipe, soldered to a band, encircling the first molar. The anchorage of this tooth is further reinforced by a piece of the gold wire which is slipped through a tube soldered to the buccal surface of this band, the end of the wire resting against the adjoining teeth."

Occasionally it is possible to move a cuspid inward and at the same time provide room for its accommodation by pressing the adjoining teeth apart.

FIG. 105. FIG. 106.



Creating Space and Moving in Cuspid. (Matteson.)

Prof. Matteson* illustrates and describes the use of a novel, but simple, fixture for providing space and moving a tooth into line at the same time. It is shown in position in Figs. 105 and 106. It consists of two flexible metal strips attached to and held apart at their inner ends by a suitably-shaped wire made long enough to rest upon the palatal surfaces of the two teeth bordering the space to be occupied by the cuspid. At their outer extremities these metal bands

* *Dental Cosmos*, Vol. XXXIV., p. 247.

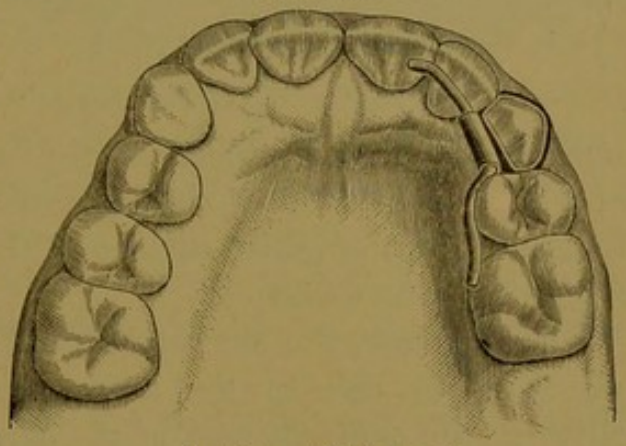
were arranged to engage with a curved bolt and nut overlying the outstanding cuspid in such a way that when in position, as shown, the turning of the nut would draw the ends of the strips toward one another and thus force the cuspid inward at the same time that the adjoining teeth were forced apart to provide accommodation for it.

Fig. 105 shows the appliance as first used and Fig. 106 the same with a longer wire substituted for the shorter one after the latter was rendered unserviceable by the moving of the tooth.

In the case in hand, after the preliminary wedging, only two weeks' time was consumed in bringing the cuspid into place with the appliance, as described, although the patient was a well-developed man twenty-two years of age.

The tooth was retained in place by means of a tubed band cemented to it with wire inserted to rest against adjoining teeth, as shown in Fig. 107.

Fig. 107.



Retainer. (Matteson.)

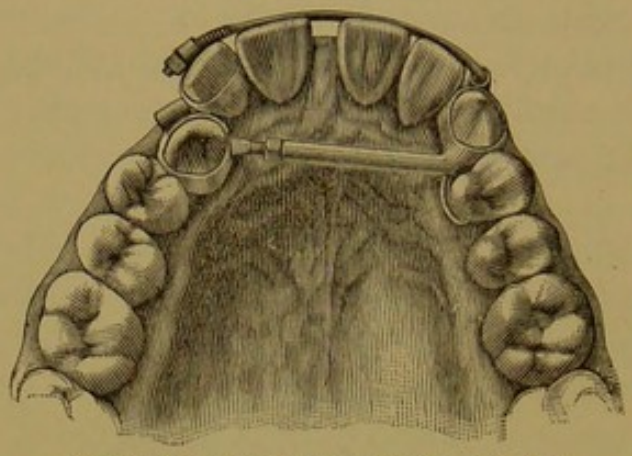
When a superior cuspid erupts inside of the arch the difficulties attending its being brought into position are far greater than when it erupts externally. This is partly due to the fact that the space between it and the opposite side of the arch is too limited to admit of the use of some of our best power-yielding appliances and partly, also, to the thickness of the alveolar process in which it is embedded and that will have to be resorbed before the tooth can assume its proper position.

The power to be applied to an inlying cuspid must necessarily be very great to carry with it any prospect of success. A solid Coffin plate, with a very stiff piano-wire embedded

in it will yield the greatest amount of spring power, but where this is insufficient we must needs resort to the screw-jack in some of its forms.

An appliance of Dr. Angle's, as shown in Fig. 108, for forcing outward a cuspid is neat, simple and effective.

FIG. 108.



Screw-Jack Moving Out Cuspid. (Angle.)

"The base of the screw-jack is soldered to a band encircling the opposite cuspid and reinforced by a spur resting against the first bicuspid, and also by the large traction screw which is hooked into a pipe soldered to the labial surface of the band and passing in front of the incisors through a tube soldered to a band on the labial surface of the lateral incisor, against which the nut works.

"In this case, the left central and lateral were moved forward in the line of the arch, thereby closing the space between the centrals, and, at the same time, providing space for the out-moving cuspid. The large screw was beaten flat and polished before insertion."

CHAPTER IV.

MISPLACED BICUSPIDS.

The bicuspid teeth, both superior and inferior, are often found located outside or inside of the normal arch line, but their mal-position is not of as frequent occurrence as that of the anterior teeth.

Their position out of line, as in the case of most forms of individual irregularity, is due to lack of space or the crowding of other teeth. Sometimes, through tardy eruption, their space in the arch has been encroached upon by the pressure of the erupting cuspids in front, as well as the forward-moving tendency of the molars. In such cases one or both of the bicuspids are compelled to assume a position outside or inside of the arch, the latter being the one they most commonly take.

Again, their predecessors, the deciduous molars, frequently have their crowns destroyed by caries long before the time for their natural removal, while their roots remain. Inducement is thus offered for the adjoining teeth to occupy part of the space, and the bicuspids are forced to erupt in an abnormal position.

In other cases, they may have taken their places in line, or nearly so, and are subsequently forced out of place by the effort of the cuspids to occupy their places in the arch. The ease with which they may be forced out of position is readily understood when we consider that their roots are conical and rather short, and that they are placed between teeth that are firmly set and have either a single long root firmly implanted, like the cuspids, or several roots, like the molars. Their dis-

tinctly convex approximal surfaces also greatly favor their displacement.

The second bicuspid is more frequently found out of line than the first, probably because of its later eruption.

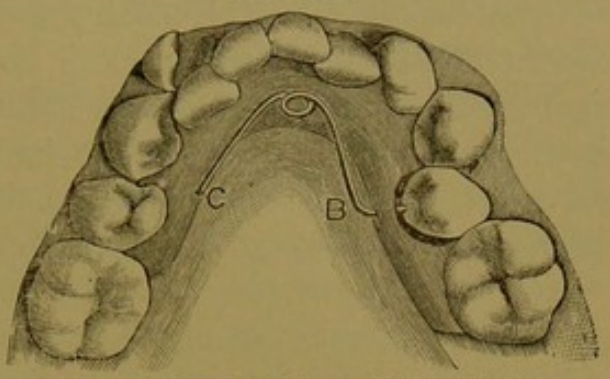
The lack of alignment of one or both bicuspids is sometimes associated with a greater or less degree of torsion, but this is not of common occurrence, and when met with is either corrected in the act of bringing the tooth into line or will have to be remedied by a separate operation afterward.

The greater or less difficulty of bringing into line one or more bicuspids situated inside of the arch will usually be entirely dependent upon the amount of space existing for their accommodation. If much of their space in the arch has been pre-occupied by adjacent teeth, these will first have to be pressed apart to afford accommodation. Should full or nearly full space exist for them in the arch, they may usually be forced into line by the elasticity of a vulcanite plate, or of metal in some form of spring. Where it is designed that the moving tooth shall make room for itself as it advances, the greater power of the screw-jack will be required.

A simple method of moving a bicuspid, either upper or lower, outward into line is to obtain a plaster model of the jaw. The plaster tooth representing the one to be moved should then be cut away on its palatal or lingual surface until this portion of it is in line with the same surfaces of the adjoining teeth. A vulcanite plate made upon this model with a piece of piano-wire embedded in its central portion, if it be for the lower jaw, will, by its elasticity, soon bring the tooth into position. Or, we may make the plate upon the unaltered model and then insert a wooden peg in a hole drilled in the plate opposite the tooth to be operated upon. Or, instead of the wooden peg, a metal screw may be inserted so as to act upon the tooth. By setting the screw well into the rubber plate, it may be elongated by unscrewing from time to time until the object is attained.

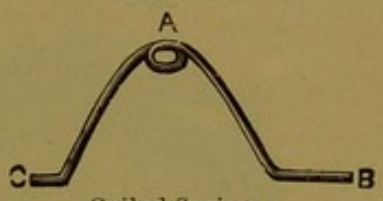
Dr. Talbot has devised an excellent method of forcing one or more bicuspids into line by means of a coiled spring of piano-wire, in connection with a rubber plate to hold it in position and properly direct its action. Fig. 109 represents the appliance in position. Dr. Talbot says: *"A thin, narrow, close-fitting, vulcanite plate was made, and a hole drilled through the middle of it opposite the centre of the tooth to be moved. In the other side, another hole was drilled, but not quite through the plate. A suitable spring, Fig. 110, was then made of piano-wire, having a single coil A, and the ends of its arms bent at about a right angle. One of these ends, C, was cut short to enter the corresponding hole in the plate, and the other end, B, left long enough to go through the plate and impinge on the lingual surface of the bicuspid, leaving a full eighth of an inch between that arm of the spring and the plate, as is clearly shown by Fig. 109, where the spring is in position to act upon the tooth to be moved. Both the spring and the plate may be removed instantly, either for cleansing purposes or to increase the power of the spring by spreading its arms or to open the coil so that the tooth may be held steady at the point to which it has been moved. Fig. 111 shows a spring having two

Fig. 109.



Talbot's Vulcanite Plate and Coiled Spring.

Fig. 110.



Coiled Spring.

Fig. 111.

Coiled Spring.

Dental Cosmos, Vol. XXVIII., pp. 286-7.

long ends, B B, which is designed for a case in which two such teeth are to be moved in opposite directions."

The advantage of this appliance is that it operates without occupying any of the space between the teeth, which in most cases is important.

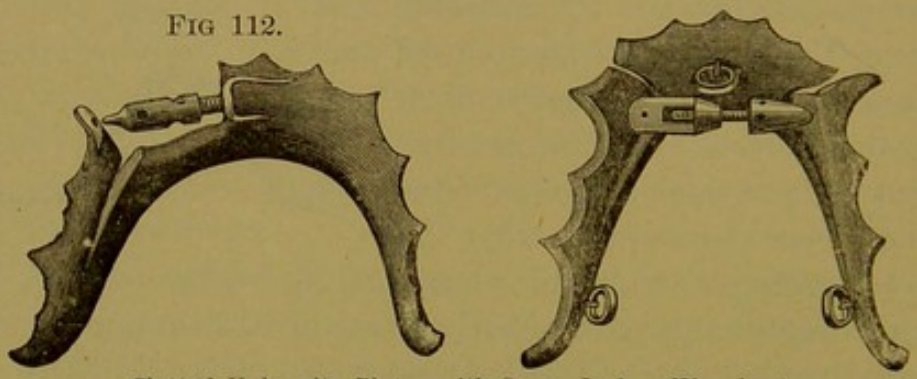
Where there is no great crowding, however, Magill bands may be attached to the anchor tooth or teeth and the one to be moved, and the Talbot spring made to rest in suitable depressions formed in them. In this way the objection to a removable rubber plate may be done away with.

Where the superior power of the screw-jack is to be taken advantage of, Dr. Kingsley's method of using it in combination with a slotted vulcanite plate is one of the best.

The accompanying illustrations, Figs. 112 and 113, copied

Fig 112.

Fig. 113.



Slotted Vulcanite Plates with Screw-Jack. (Kingsley.)

from Dr. Kingsley's work,* represent some of the ways in which he accomplishes movements, slightly varying in character. Fig. 112 operated to move outward both bicuspids of the left side inferior, the first more than the second; while Fig. 113 moved all four of the inferior bicuspids.

Where it is desired to avoid the use of a plate, Magill bands, re-enforced, drilled and counter-sunk, may be cemented to the teeth to be moved and the screw-jack inserted between them. Prof. Angle's device for expanding the arch, as shown and described on page 104, may also be

*Loc. cit.

advantageously used for moving outward one or more of the bicuspids. It will be noticed that in the operation of this appliance any instanding teeth are moved outward into line before real expansion of the arch begins; if, therefore, the moving of individual teeth is alone desired, operations can be suspended as soon as that object has been accomplished.

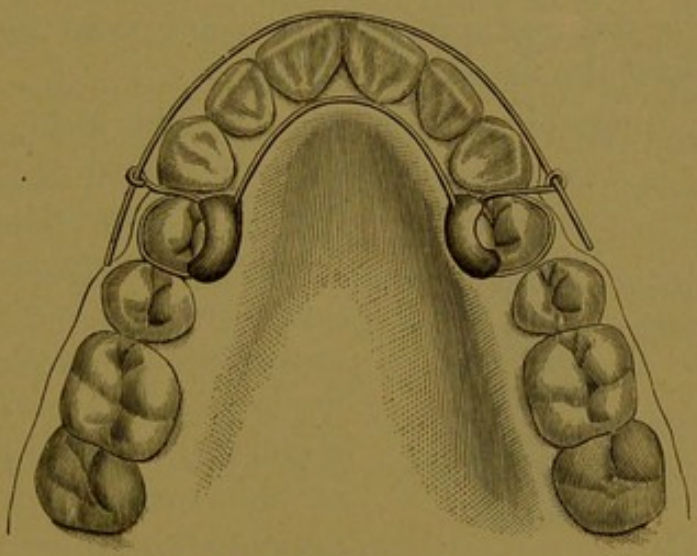
The small size of the screw-jack in the Angle device is also an element in its favor, since it will interfere less with the movements of the tongue than the larger ones commonly used.

In addition to the power of the screw-jack, it has the further advantage of rapidity of action; so that, if its position in the mouth should somewhat inconvenience the patient, it would do so only for a very short time.

Dr. Jackson has very ingeniously adapted his spring and crib method to the moving of bicuspids,as shown in the following illustrations:—

Fig. 114 illustrates his appliance for moving outward two first bicuspids.

FIG. 114.



Spring and Crib Appliance. (Jackson.)

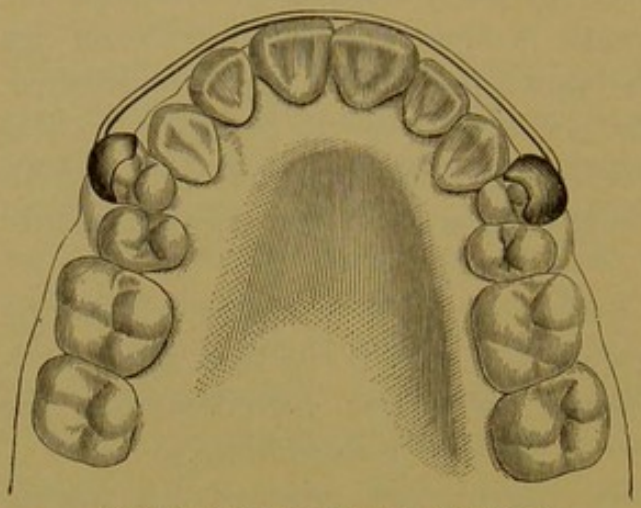
*"A base wire is shaped to the lingual side of the anterior teeth and anchored to the bicuspids by means of single crib appliances. To each of these latter is attached a hook or eyelet to sustain a straight bar of spring wire that is sprung over the anterior teeth." By this means the bicuspids may be moved outward and the arch flattened in front at the same time, when desired.

Dental Cosmos, Vol. XXXIII., p. 1077 et seq.

For moving the bicuspids inward, he employs a device like that shown in Fig. 115.

"Thin metal is fitted to the labial surfaces of the teeth to be moved, being made to extend well towards the necks and distal surfaces of the teeth. A good-sized spring wire is then formed to follow the outline of the anterior teeth on their labial surfaces and extend to the metal clasps, to which it is soldered.

FIG. 115.



Moving Bicuspids Inward. (Jackson.)

"The appliance should be removed from time to time and the clasping ends of the spring bent toward each other to exert the pressure required."

A simple wire fixture, by the same writer, for moving either outward or inward a single bicuspid, is shown in Fig. 116.

FIG. 116.

Simple Wire Spring. (Jackson.)

"A spring wire is bent in the form of a crib surrounding the misplaced tooth and an adjoining one on each side, passing well up toward the gum on the labial and lingual sides, with the ends of the spring wire terminating and overlapping upon the tooth to be moved.

"The elasticity of the spring will exert the necessary force to move the tooth."

CHAPTER V.

TORSION.

For want of a better term the word torsion, as applied to the teeth, is used to signify that condition in which a tooth is found to be turned upon its axis. Rotation refers to the act of twisting or turning a tooth so as to bring it into normal position. Torsion, therefore, will describe the condition, and rotation the operation.

Torsion is usually due to some abnormal influence operative before or during eruption. Lack of space will often impel a tooth during eruption to turn in such a way as to present its smaller diameter toward the space intended for its accommodation, in order to occupy that space at all. A root, or even a portion of one, will also often cause a tooth to partly turn in its socket while seeking its position in the arch. Torsion of the superior central incisors, so often met with, is doubtless due in the majority of cases to undue thickness of the median alveolar septum. The condition is also produced after eruption by the crowding of adjoining teeth, induced by some unusual pressure, such as the effort of a later erupting tooth to occupy its place in the arch.

Torsion is met with in all degrees of extent, from the slightest prominence of one corner of a tooth to a complete half-turn.

It occurs generally in single-rooted teeth, or in those with a slightly bifurcated root; and among these, those with roots most nearly round are the ones commonly affected on account of the ease with which they can be made to turn upon their axes.

At times cases are met with in which two adjoining teeth are thus affected, usually each in like degree, this variety of the condition being known as Double Torsion.

Rotation is usually not a very difficult operation in itself, but when complicated by the crowding or disarrangement of adjoining teeth it sometimes proves quite troublesome.

Where there is sufficient space in the arch to accommodate the tooth after it has been turned, we have simply the matter of rotation to deal with, but when such is not the case, our first efforts must be directed toward providing space. This may be done, if the deficiency be slight, by pressing apart the impinging teeth by some of the means described on page 128; but where great space needs to be provided, and expansion of the arch is not indicated, it will be necessary to extract some less important tooth to afford opportunity for bringing the turned tooth into line. In the case of teeth with flat crowns, as the incisors, we may adopt either of two plans for turning the tooth, viz.: grasping the crown throughout its entire circumference and applying suitable power, or by direct pressure upon one or both of the angles that are out of line. With teeth having round crowns, such as the cuspids, we are limited to the plan of making attachment to the periphery of the crown.

At one time it was difficult, if not almost impossible, to grasp a tooth so securely as to have the attachment resist the strain of the applied power, but since the introduction of the Magill band this greatest of all difficulties associated with rotation has been overcome.

One of the simplest and most effectual methods of rotating a flat-crowned tooth is by the use of a rubber plate made to cover the palate and envelope the posterior teeth on either side, according to the Coffin plan. To the palatal portion of the plate a piano-wire is attached so as to bear upon the inner corner of the tooth to be turned, while a similar wire imbedded in the buccal portion of the plate is arranged to press upon the corner that projects. The bending of the wires from time to time, to increase the tension, will speedily accomplish the desired result.

Where only one corner of a tooth stands out of line, the

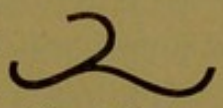
plate just described may be modified by having but a single wire to press inward the outstanding corner, and allowing the rubber plate to rest firmly against the corner that is in line, to prevent it from turning.

Opportunity for the projecting portion of the tooth to move inward, must, of course, be provided by cutting away the rubber plate at this point.

Another way of rotating a tooth is to fit a band or ferrule of gold or platinum to it with a headed platinum tooth-pin soldered to its labial face near the angle that is out of line. A delicate vulcanite plate is then made to fit the roof of the mouth, and into it at a suitable point is screwed a threaded gold wire with a slight curve or hook on its end. After the band is cemented to the tooth, it is connected with the gold hook in the plate by means of a rubber ring. Should it be desirable to change the point of attachment on the plate, it can be done by drilling a new hole at the desired point, and screwing a hook into it. The plate can be removed for cleansing and new rubber rings applied by the patient. This plan is effective in cases where no great power is required.

To aviod the inconvenience of wearing a plate during the school-age, the author many years ago devised a small and inconspicuous appliance for rotating a single incisor. It is shown in outline in Fig. 117, and is constructed as follows:

FIG. 117.



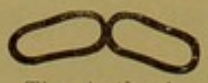
The Author's Rotating Device.

A strip of platinous gold about an eighth of an inch in width, and gauge No. 24 in thickness, is bent to conform to the outline that we wish the turned tooth and its neighbor to describe when in normal position. Each end of this strip is bent to partly encircle the disto-palatal angle of each tooth, after which another strip of gold, of similar width but thinner, is soldered to the centre of the first piece. This last piece should be long enough to extend between the teeth and embrace the protruding edge of the tooth to be turned.

By bending this arm so short that the appliance will have to be sprung into place, pressure is brought to bear upon the tooth that will cause it to rotate in its socket. The appliance should be removed each day, the length of the arm shortened by bending, and replaced. To guard against loss or accident, a ligature of sewing silk should be tied around the neck of one of the teeth and made fast to the appliance. About ten days will usually suffice to bring the tooth into proper position.

The tooth once in place, is readily retained by means of the small retainer shown in Fig. 118. In its construction, similar bands are made to fit both the corrected tooth and its neighbor, after which they are joined by solder at the point where they touched when in place. To add stiffness, another strip of gold should be soldered to the palatal surface of the fixture. When completed and polished, it is lined with phosphate of zinc and placed in position upon the teeth.

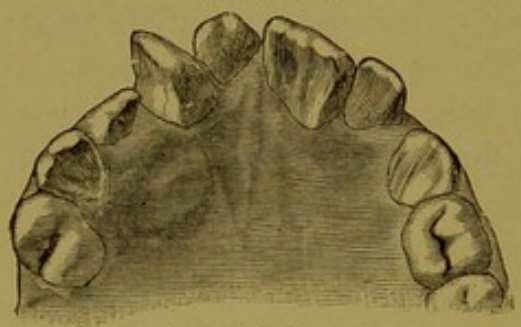
FIG. 118.



The Author's Retaining Fixture.

By the use of this retainer, which occupies but little space, the tooth is held so rigid in its new position that it becomes firm much more rapidly than it would under other circumstances. Should the force exerted by the effort of the corrected tooth to return to its former malposition be so great as to affect the tooth used as anchorage, this tendency may be prevented by soldering a spur of gold to the appliance at a suitable point, and allowing this to rest against some firm tooth near by.

FIG. 119.



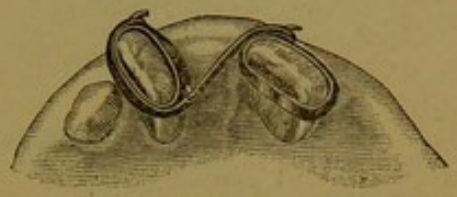
Torsion Caused by Supernumerary.

A case in the practice of the author will illustrate a ready means of correcting an extreme case of torsion. The patient was a Japanese boy, nine years of age, whose upper denture when he applied for treatment presented the ap-

pearance shown in Fig. 119. The left deciduous lateral was still in place, while the right permanent lateral was just appearing through the gum. Both permanent centrals were fully erupted, but owing to the presence of a supernumerary tooth in the centre of the arch the right central was crowded far out of its place and turned upon its axis.

After extracting the supernumerary and the deciduous lateral, platinum bands were fitted to the centrals, with a gold hook soldered to each at points that would furnish the greatest amount of tractile power. After the bands were cemented in place a rubber ring was stretched from tooth to tooth, in the manner shown in Fig. 120.

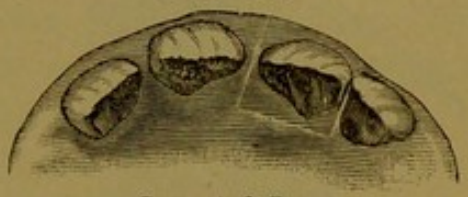
FIG. 120.



Bands and Rubber Ring for Rotation.

The malposed tooth was thus readily brought into contact with its fellow, and at the same time considerably straightened. Its further and complete rotation was then accomplished by an appliance somewhat similar to that shown in Fig. 117, after which it was retained by the retainer shown in Fig. 118. As the left central had been somewhat loosened in the act of rotating its fellow, it was found necessary, in order to secure stable anchorage, to attach a spur to the appliance and have this rest against the palatine surface of the right lateral, which was by this time almost fully erupted. In six months the teeth were firm in their new position, as shown in Fig. 121.

FIG. 121.

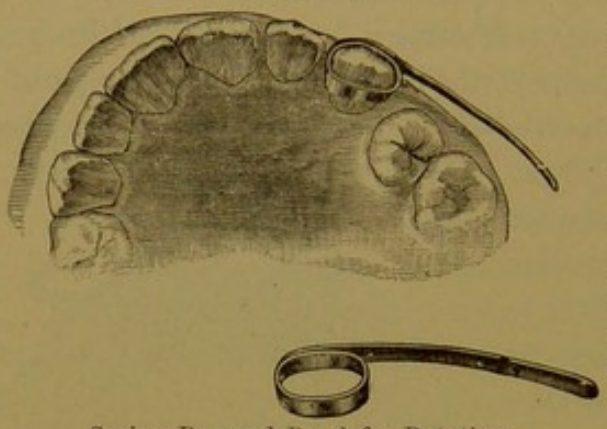


Corrected Case.

A simple and very effectual method of accomplishing the rotation of any tooth, without regard to the form of the crown, and one, too, in which the use of a plate is dispensed with, is illustrated in Fig. 122. It consists of a platinum or gold band made to fit the tooth to be rotated, and having an extension bar of heavy platinized gold soldered to its labial surface. The free end

of the bar is perforated by two holes for ligation to some firm tooth, usually a molar. In use, the band is cemented to the tooth and the bar sprung down and ligated to the tooth selected for anchorage. The immense leverage of this bar will quickly compel the tooth to turn in its socket. As its force becomes spent from time to time the bar can be bent outward with pliers, without removing it from the tooth. After the tooth has been brought into proper alignment, it is most conveniently held in position by means of the retainer shown in Fig. 28. It may also be retained by a rubber plate having a gold spur to pass between the teeth and rest upon the portion of the tooth that has been moved inward.

FIG. 122.

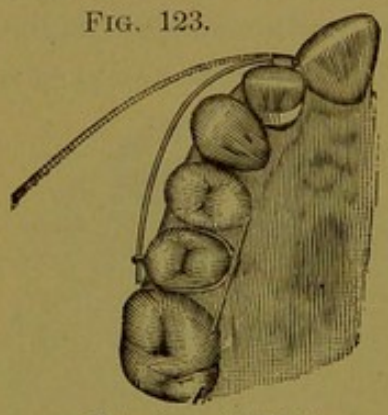


Spring Bar and Band for Rotation.

Prof. Angle has improved this appliance by making the band and bar detachable.

The band is fitted with a section of German silver tubing soldered to its labial surface, parallel with the cutting edge of the tooth. Another band, with a hook or catch soldered to its buccal surface, is fitted to a bicuspid or molar. This latter band also has a piece of tubing soldered horizontally to its palatine surface, through which is passed a piece of wire intended to rest against the two teeth adjacent to the one banded and thus afford greater resistance. After both of these bands are cemented to their respective teeth, a straight piece of piano-wire is inserted in the tube of the tooth to be turned, and bent down and caught in the catch on the other

FIG. 123.

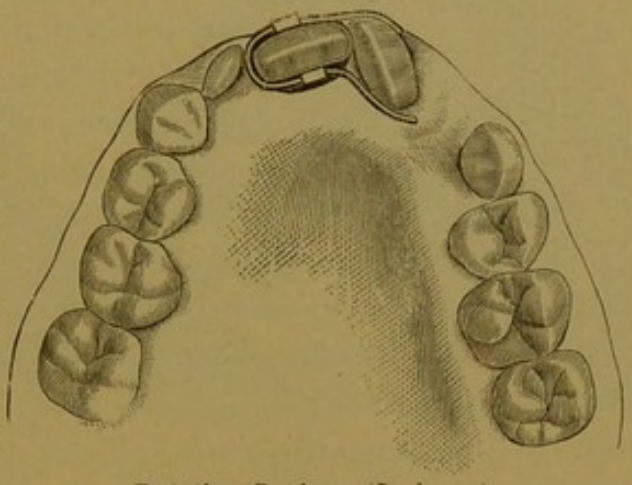


Rotation. (Angle.)

tooth, as shown in Fig. 123. The advantage of this modification is, that a weaker or stronger wire can be substituted at will, and the power be thus readily controlled. When the tooth is in proper line, the wire is removed and replaced by a shorter one resting upon an adjoining tooth. This acts as a retainer by keeping the tooth in position until it has grown firm. The retaining wire is secured by means of a pin, inserted in a hole drilled through both tube and wire.

Another simple device devised by Dr. Jackson* for rotating a single incisor is illustrated in Fig. 124. It consists of a band or collar, made to encircle the one incisor, to which are attached upon the labial and palatal surfaces two lugs to receive a U-shaped wire. One arm of this wire spring lies upon the labial side of the teeth and produces pressure upon the mesio-labial corner of the turned tooth while the other extends along the palatal surface and presses upon the disto-palatal angle. Pressure in opposite directions is thus accomplished, while the balancing of the two forces prevents the anchor tooth from turning. The appliance is too small to in any way interfere with speech or occlusion.

FIG. 124.



Rotating Device. (Jackson.)

DOUBLE TORSION.

Where two adjoining teeth, as the superior centrals, are to be rotated in opposite directions, a single appliance will often accomplish both movements at the same time. The appliance devised by the author for this purpose is shown in Fig. 125, and the details of construction in Fig. 126. It is a modification of the appliance for single rotation shown

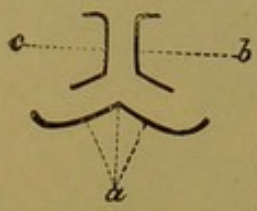
Dental Cosmos, Vol. XXXIII., p. 1076.

on p. 159. To adapt it for duty in turning two teeth, instead of the single strip of gold passing between the teeth, two strips are bent in the form of "b" and "c." These are made long enough to be bent slightly over the labial surfaces of the teeth to be turned, extend along the mesial surface to the palatine, and then along this latter almost to the distal angle. After being properly shaped according to the model, they are clamped together and soldered along their contiguous surfaces. This part is then placed in position on the model, and the long arms bent to conform to the inner surface of the bar "a," after which it is removed, soldered to "a," and the part "b" "c" reduced in thickness by filing, so as to occupy as little space between the teeth as possible. When properly constructed the labial part of the appliance will rest against the teeth just at or slightly above the most prominent points of their convexity, while the lingual portion will be near the gum, but not quite touching it, and the slightly curved ends of this part will catch just above the little prominence usually found at the disto-palatine angle near the gum.

Fig. 125.

The Author's Device for Double Rotation.

Fig. 126.



Thus made and placed, the piece cannot become displaced by the lip or tongue, except when loosened by the moving of the teeth. As will readily be seen, by its use force is brought to bear upon four points of the two teeth at one time.

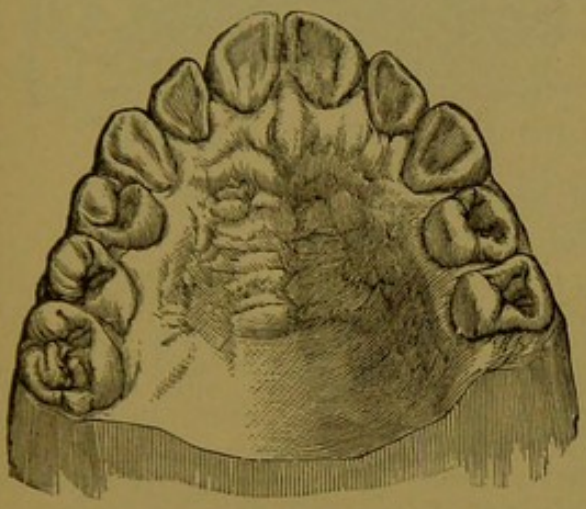
A valuable feature of the appliance, had in view in its devising, is that it occupies but one interdental space, and thus more readily favors the turning of teeth that are more or less crowded.

In use, the patient should be seen each day, the fixture removed and tightened by bending the long arms slightly toward the smaller ones and sprung into place.

To facilitate its introduction in the first instance, a piece of rubber should be placed between the teeth one day previous to the insertion of the appliance.

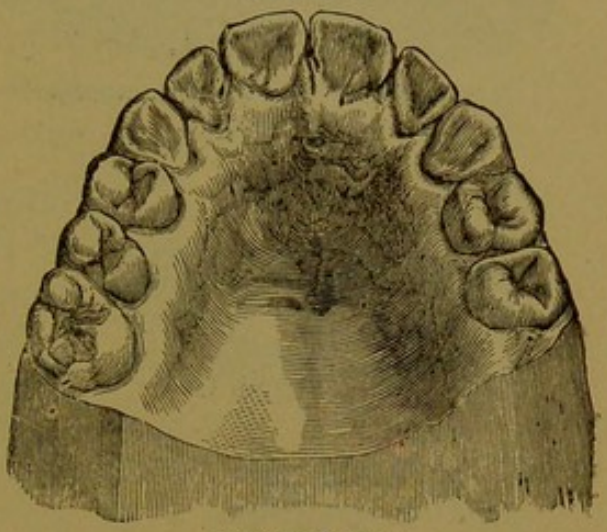
As in the case of the appliance for single rotation, a thread should be tied around one of the teeth and attached to the front bar to guard against the swallowing or loss of the piece. Fig. 127 represents a case of double torsion which was corrected in ten days' time by the use of the appliance just described, the patient being seen every day; while Fig. 128 shows the completed operation. After the teeth are in posi-

FIG. 127.



Double Torsion.

FIG. 128.



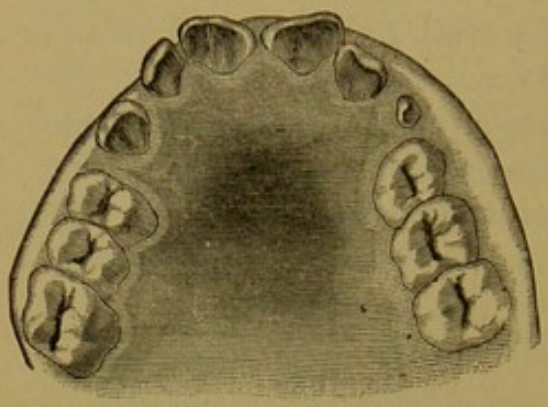
Corrected Case.

tion, they may be best retained by means of the retainer shown in Fig. 30.

When the distal corners of the teeth project instead of the mesial, the appliance described is rendered equally serviceable by reversing its position and placing the long arm on the labial surface. Fig. 129 represents a case of this character, while Fig. 130 shows the vulcanite plate with gold wire bow that was used to retain the teeth after correction. A simpler and better method of retention would have been to use the appliance shown in Fig. 118.

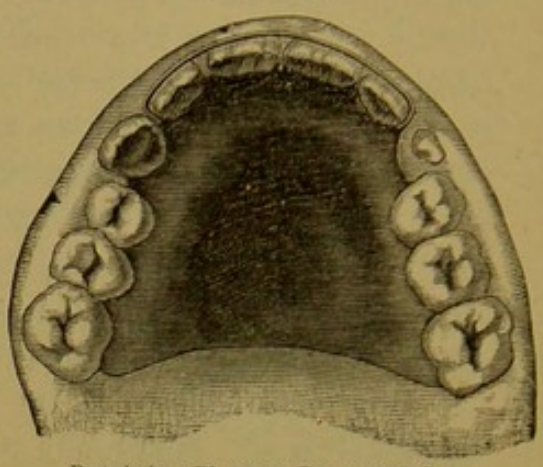
Prof. Angle has devised a very simple and effective method of accomplishing double rotation where the mesial angles protrude. Upon each of the teeth to be rotated he places Magill bands with tubes soldered to their labial faces near the distal angles. One tube is set vertically and the

Fig. 129.



Torsion of Centrals, with Distal Angles Pointing Outward.

Fig. 130.



Retaining Plate on Corrected Case.

Fig. 131.

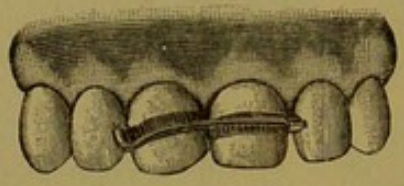
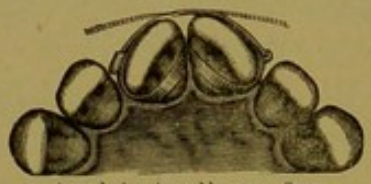


Fig. 132.



Angle's Appliance for Double Rotation.

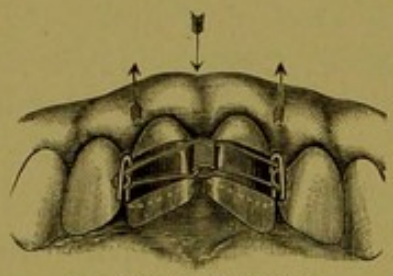
other horizontally. A short piece of piano or German silver wire, bent to a right angle at one end, is inserted into these tubes and rotation is effected by the elasticity of the wire.

Two views of the appliance are shown in Figs. 131 and 132.

Once in position, the teeth are retained by inserting in the tubes a suitably-shaped piece of non-elastic gold wire.

Another modification of the Siegfried spring, designed to produce double rotation is shown in Fig. 133. The central coil, in this case, rests in the groove between the two teeth, while the wings engage with wire loops soldered to the bands near their distal surfaces.

Fig. 133.



Siegfried Coil Spring.

As the force of the spring is necessarily limited, it can only be used to advantage on teeth of very young patients and in cases where there is sufficient space for their rotation.

CHAPTER VI.

CONTRACTED ARCH.

A contracted arch may be due to lack of development, caused by late or mal-eruption of some of the teeth; to the loss of certain of the permanent teeth soon after their eruption; or to malposition of the teeth in the opposite jaw.

The late eruption of the superior cuspid teeth, where their spaces have been preöccupied by teeth anterior and posterior to them, is perhaps the most frequent cause of this deformity.

In some cases, the contraction is limited to the molar and bicuspid region; in others, to the anterior alone; while in others still, the entire arch needs expansion.

The enlargement of the arch, either at certain points or in its entirety, may be accomplished by a variety of methods.

Where lateral expansion is desired, it may usually be brought about in a simple manner by the use of the Coffin split-plate, the construction and operation of which are described on p. 106.

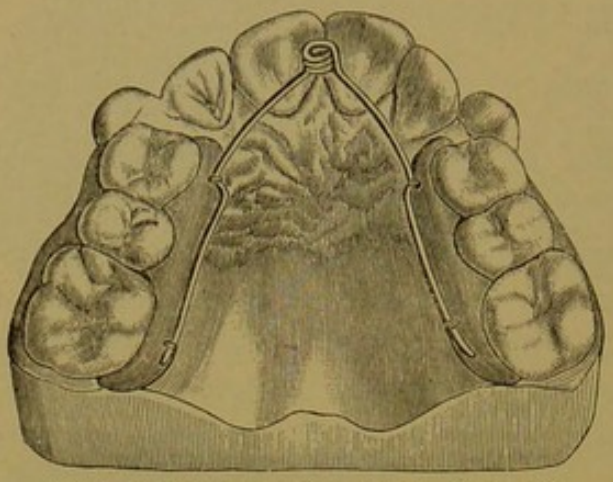
Another form of appliance, intended to accomplish the same purpose and constructed of piano-wire and vulcanite, has been devised by Dr. Talbot, and is illustrated in Figs. 134 and 135.

In his description, he says:* "A (vulcanite) plate is made to fit the teeth and alveolar process, and cut away so that the anterior parts extend far enough forward to enclose the teeth to be moved. A piece of (piano) wire is bent into either of the forms shown in Fig. 135, wherein 'a' is the coil and fixed point, 'b b' movable arms extending from 'a,' and 'c c' movable arms extending from 'b b.' Grooves

*Talbot's Irregularities of the Teeth. 2d Ed., p. 221.

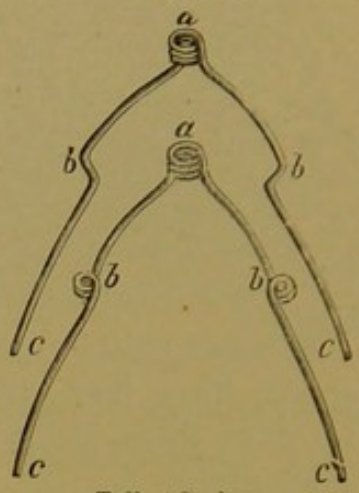
are cut into the anterior and posterior parts of the plate to correspond with and receive the points 'b b' and 'c c.'

Fig. 134.



Appliance for Lateral Expansion. (Talbot.)

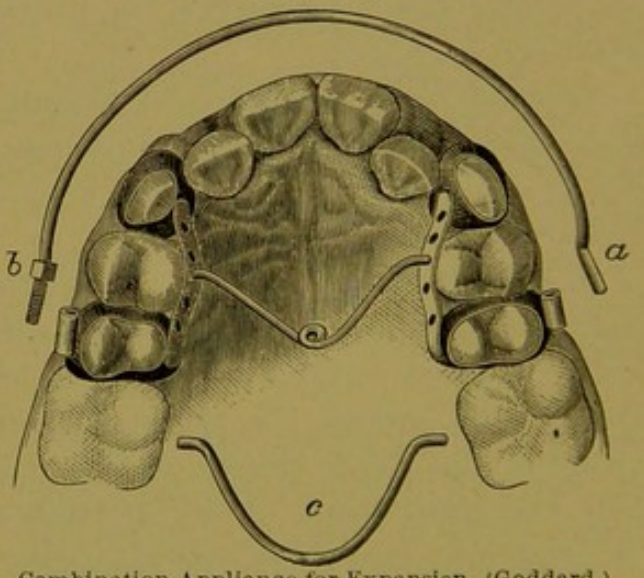
Fig. 135.



Talbot Springs.

Holes are drilled at these points, and the wires tied to the rubber plates. In order that the anterior teeth may be moved with the greatest force, the arms are so adjusted that the greatest pressure is exerted on the anterior parts of the plates. This appliance is readily removed for cleansing, and returned to place by the patient."

Fig. 136.



Combination Appliance for Expansion. (Goddard.)

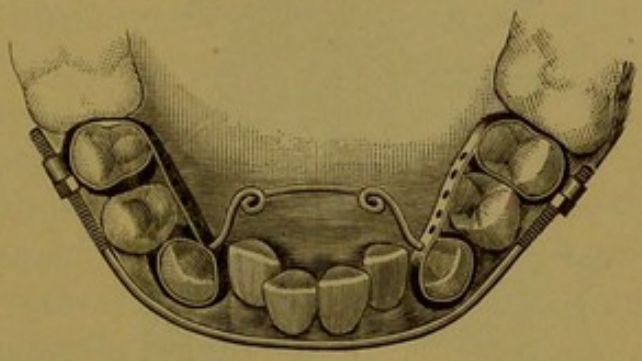
Prof. Goddard employs the Talbot spring for lateral expansion, dispensing with the rubber plate and using instead, band and bar attachments to the teeth, as shown in Fig. 136. The cut so fully illustrates the appliance that very little explanation is needed.

The holes in the bars on either side are for the reception of the coiled spring

which can be placed either forward or backward, according as one part calls for more expansion than the other. After the arch has been widened, the bent wire "c" is substituted for the coiled spring, and retains the advantage gained. The long wire "a" "b" is intended to be used where any of the incisor teeth need to be moved forward. In such case its ends are inserted into the tubes on the bicuspid bands and rubber rings are passed over it and the in-lying incisors. To prevent the ends of this wire from slipping through the tubes they may be threaded and supplied with a nut, as shown at "b," or they may be bent to a bayonet-shape as shown at "a."

A somewhat similar appliance for use in the lower arch, also devised by Prof. Goddard, is illustrated in Fig. 137.

FIG. 137.

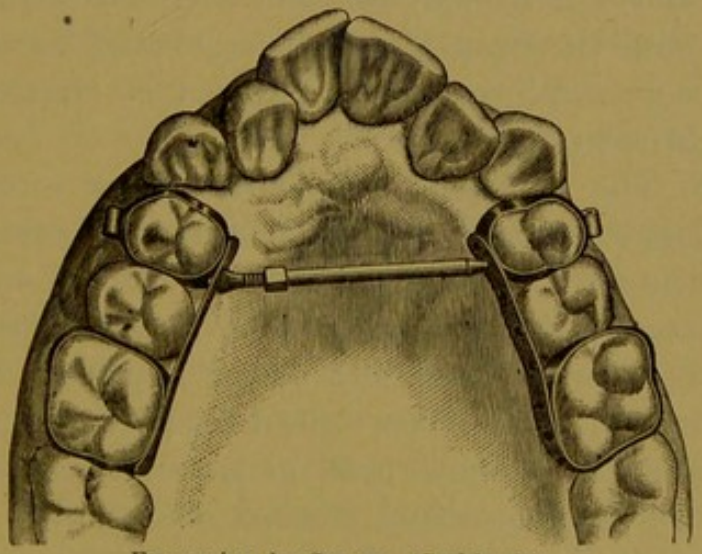


Expansion of Lower Arch. (Goddard.)

In this case, as in the other, the long wire was used for attachment in drawing forward the in-locked laterals.

Where more force is required than can be obtained from either of the appliances just described, it can be had by the more direct power of the screw-jack, which hastens the operation and lessens the period of inconvenience to the patient.

FIG. 138.



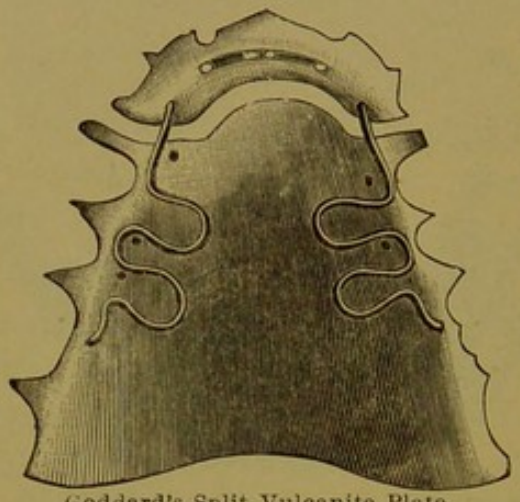
Expansion by Screw. (Goddard.)

Fig. 138 shows a simple method of using the screw and the manner in which it can be applied in different

locations along the line of the arch. The bands, bars and screw are preferably made of German silver. The screw and tube in which it operates being of the Angle pattern. Other ways of using the screw in connection with a vulcanite plate are shown on p. 154.

When expansion of the anterior portion of the arch is desired, it may be accomplished by means of one of the appliances shown on pp. 130 and 131, or by a modification of the Coffin split plate devised by Prof. Goddard. The latter is shown in Fig. 139.

Fig. 139.



Goddard's Split Vulcanite Plate.

As will be seen, there are two corrugated piano-wires attached to the vulcanite plate, one on each side near the free margins, while the plate is split laterally just back of the incisor teeth. As in other split plates for anterior expansion, this plate is made in one piece and the wires arranged so that their anterior ends are embedded in the portion to be detached, while the posterior ends are fastened to the main body of the plate. After the completion of the plate the front portion is separated by means of a jeweler's saw, and pressure is produced by stretching the wires from time to time.

The anterior portion is kept down to its place by being ligated to the central incisors. In using this form of plate the author has found it more convenient to hold the front portion down by imbedding in the plate a gold spur, to pass between the centrals in the free space near the gum. He also prefers to secure the main portion in position by making the plate to cover and grip the bicuspids and molars, as in the Coffin method, instead of fastening it to the side teeth with ligatures. The appliance is admirably adapted to the purpose for which it was devised.

Where expansion of the entire arch is desired, a better plan, in most cases, is to accomplish it by separate operations. Lateral expansion, for instance, can be accomplished first, and after the bicuspids and molars have been brought into proper position, they may be retained by means of a rubber plate covering them. This plate will not only hold them firmly, but serve as an anchorage to which other fixtures may be attached for the expansion of the anterior portion of the arch, as in the Goddard plan.

The details of a case of general expansion of the superior arch, may be of interest to the student.

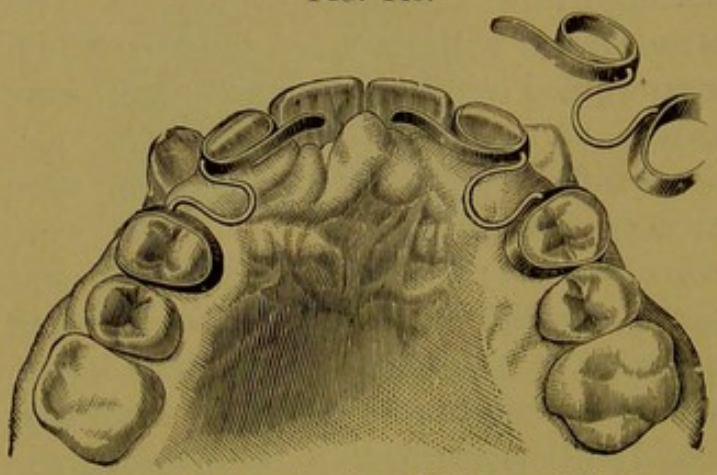
The patient was a boy of about fifteen years of age. The inferior arch was of normal size, with the teeth well arranged. In the superior arch, all of the teeth except the cuspids articulated inside of the lower ones, giving the patient a pinched or contracted appearance in the region of the upper lip. The laterals were almost in contact with the first bicuspids, while the cuspids had fully erupted outside of the arch and were overlying the laterals.

Extraction was not indicated, for all of the teeth were needed to fill the arch after its expansion.

By means of a Coffin split-plate, lateral expansion was accomplished in about a month, so that the bicuspids and first molar on each side occluded normally with those below. Next, with another Coffin solid plate encasing the teeth that had been moved, and with two piano-wires attached, the laterals were pressed forward; after which, new rubber was added to the plate to keep these teeth in position, and the wires changed to press the centrals forward into line with the laterals. After this had been accomplished there was still insufficient space for the accommodation of the cuspids, and as the incisors were already so far forward that pressure could not advantageously be brought to bear upon them from the rear, another plan for increasing the cuspid space was decided upon. Magill bands were made to fit the laterals, with gold spurs extending along the palatal surfaces of the cen-

trals to insure uniform movement of the four incisors. Platinum bands were also attached to the first bicuspids. All of these bands we reënforced with an additional piece of platinum soldered to the portion next to the space. Through these reënforcements, at about the centre of the tooth, holes were drilled entirely through the bands. Piano-wire was next bent into the form of small U-shaped springs with the ends at right angles. Grasping these near the neck with a pair of narrow-beaked right-angle forceps transversely grooved near the points to seize the wire, the springs were placed in position with their ends resting in the holes of the bands. As, from time to time, the force of these springs became spent, they were removed and their power renewed by enlarging their curves. Sufficient additional space having been gained by their use, the cuspids were forced into position by means of a Coffin plate with wires attached to the buccal surfaces, extending forward and resting upon the labial surfaces of the cuspids.

FIG. 140.



Increasing Space by Curved Spring and Bands.

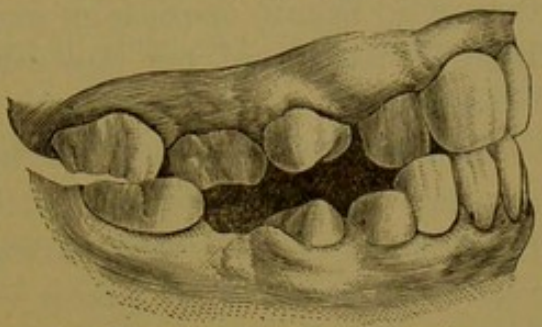
The appearance of the arch and teeth with the U-springs in position, is shown in Fig. 140. The operations were not hurried, and consumed about one year's time.

A retaining plate of vulcanite covering the roof of the mouth, with gold loops attached to overlie and retain the cuspids, was worn for nearly a year.

Another case, differing somewhat from the one just given, was that of a young girl about eleven years of age, whose superior arch did not need lateral expansion, but required

anterior enlargement to accommodate the in-coming cuspids. False occlusion of the superior incisors also needed correction. Fig. 141 represents the case as it presented. The superior centrals met the lower ones edge to edge, while the superior laterals passed inside of the lower ones. There was very little room between the superior laterals and first bicuspids to accommodate the cuspids, which, slow of eruption, were just beginning to make their appearance.

Fig. 141.

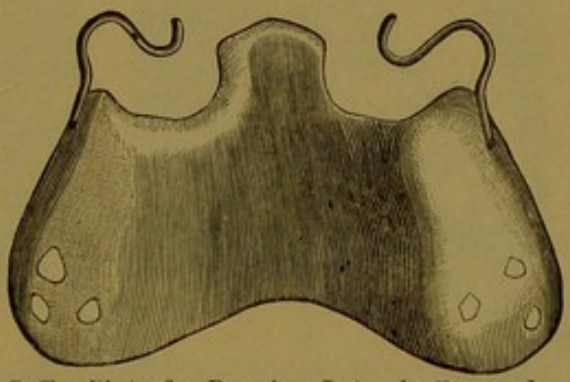


Case Requiring Anterior Expansion.

The treatment required was the moving of the laterals and centrals so as to overlap the lower ones, and the moving backward of the bicuspids on each side to afford space for the cuspids. The laterals were first moved forward into line with the centrals, by means of the plate shown in Fig. 142. This accomplished, the anterior portion of the arch was expanded by means of a Goddard split-plate.

A plain vulcanite plate, covering the arch and touching each tooth, was next made, and into it were secured on either side pieces of piano-wire bent to right angles at their free ends, the bent portions being arranged to rest upon and press against the mesial surfaces of the first bicuspids to force them backward. The plate having been trimmed to admit of the backward movement of the bicuspids, full space for the cuspids was soon gained.

Fig. 142.



Coffin Plate for Pressing Laterals Forward.

The slow eruption of the cuspids required a retaining plate to be made, armed with gold spurs at suitable points, to keep the regulated teeth in their new positions and await the full eruption of the cuspids.

At the end of six months the cuspids had assumed, unaided, their proper places in the arch, and by their key-like position preserved the arrangement without the further aid of any retentive appliance.

The case had previously been in the hands of two dentists, who began operations for correction, and it therefore became necessary for the author to carry it forward to completion.

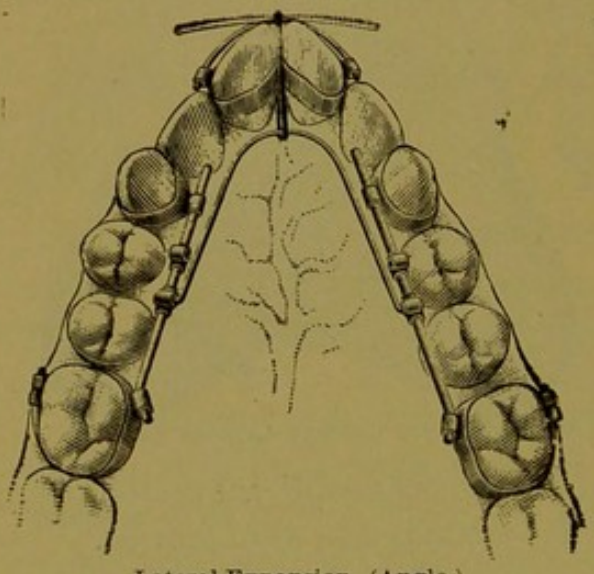
Had he been consulted in the beginning, he would have advised non-interference until two years later when the cuspids would have been partially erupted, and more nearly ready to assume their places in the arch, as soon as room was provided.

In this way the wearing of a retaining plate, to await the full eruption of the cuspids, would have been avoided and the case simplified.

Prof. Angle has devised a neat and effective appliance, constructed entirely of metal, for the lateral expansion of the arch, as shown in Fig. 143.

Like the Jackson appliances, it utilizes the principle of the Coffin spring without the objectionable features of the vulcanite plate. It can be used in either the upper or lower arch and where no greater power than the spring affords is needed, will prove very efficient.

FIG. 143.



Lateral Expansion. (Angle.)

As seen in the cut, a rubber ligature may be attached to the centre of the spring and be connected with any cross-bar appliance upon the incisors for drawing them inward when such additional movement is desired.

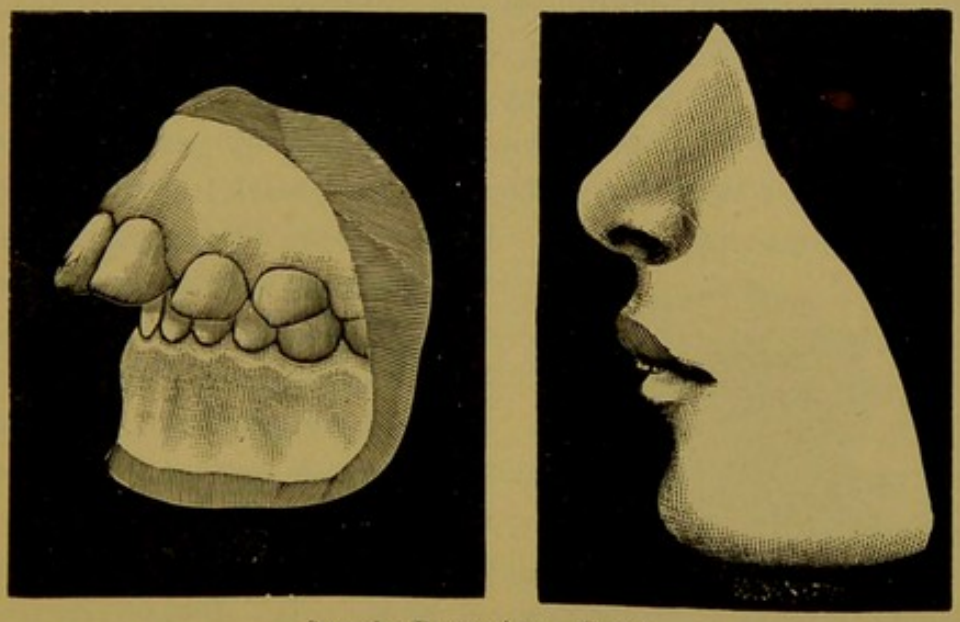
CHAPTER VII.

SUPERIOR PROTRUSION.

This deformity, so frequently met with in our day, not only destroys all harmony of expression, but so strongly suggests the facial characteristics of idiocy as to be particularly objectionable.

Fig. 144 shows the relation of the teeth in outline and Fig. 145 the facial expression. In the latter will be noticed the conspicuousness of the superior incisors and the resultant shortening of the upper lip.

FIG. 144. FIG. 145.



Superior Protrusion. (Case.)

The causes tending to produce this condition, have been briefly considered on pages 24 and 25.

There are two varieties of this deformity :—

1st. Where the deformity is confined to the protrusion of the upper teeth, the lower ones being in proper position and forming the normal curve.

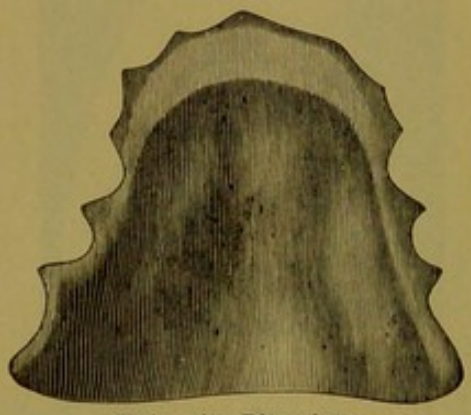
2nd. Where the teeth of both jaws are at fault, the upper ones protruding while the lower are abnormally inclined inward.

Deformity Confined to Upper Jaw.—This form is usually attributable to inheritance; to abnormal size of the teeth in the superior arch; or to the mechanical influence of pressure on the part of the posterior teeth. It is the more easily corrected on account of the operations being confined to a single arch, and yet the attendant difficulties are often very great.

In most cases of superior protrusion, the inferior incisors, from lack of occlusion, become extruded until they occlude with the base of the crowns of the superior ones or possibly impinge upon the gum tissue just back of them. In this condition they interfere with and prevent the inward movement of the upper teeth.

The first step, therefore, in such case, is to shorten the inferior incisors by forcing them back into their alveoli and, at the same time, to open the bite by permitting the extrusion or elongation of the posterior teeth. Probably the best means of accomplishing this double result is by the employment of a vulcanite bite-plate as shown in Fig. 146. It is a plain vulcanite plate made to cover the roof of the mouth and thickened in front to receive the impact of the lower incisors. It should have a vacuum-chamber to help retain it in place.

FIG. 146.



Vulcanite Bite-plate.

When in position and the mouth closed, the lower incisors should touch the plate and all of the posterior teeth be free from contact. In the act of mastication the lower incisors will be gradually forced back into their sockets while the bicuspids and molars, from lack of occlusion, will become elongated and thus open the bite.

To produce the best results, this plate should be worn for a year before any attempt at regulating is made. At the end of this time it will be found that sufficient space exists between the upper and lower anterior teeth to allow the former to be retracted.

If space exists between the teeth the operation will simply consist in applying force sufficient to move them inward. If the teeth be in contact and the protrusion is slight, space may sometimes be gained by dressing off any discoloration or superficial decay from the approximal surfaces of the six anterior teeth with sand-paper discs or emory-cloth strips, followed by thorough polishing.

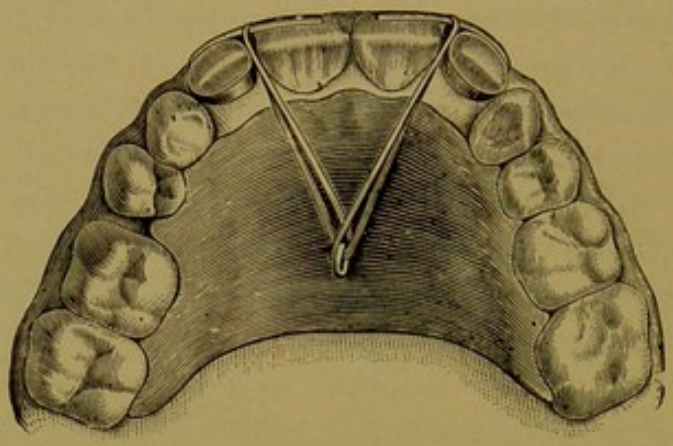
By this means the author has, in a few instances, materially improved the patient's expression, without loss of teeth or injury to tooth substance. The space once gained, the teeth can easily be brought inward by the use of a Coffin plate, cut away posteriorly to the incisors, and having gold hooks attached to the anterior portions of the plate on the buccal surface. A rubber band caught over the hook on one side, carried along the labial surfaces of the anterior teeth and attached to the hook on the opposite side, will generally provide the required tension. Small double hooks, made from half-round gold wire and hung over the cutting edges of the centrals, will, by their second curves, support the rubber band in proper place and keep it from resting upon and irritating the soft tissues. Other simple means for effecting the same result, will readily suggest themselves to the operator. Where the protrusion is of greater extent and the teeth are in contact, it will be necessary in most cases to sacrifice a bicuspid or molar on one or both sides of the mouth to obtain sufficient space to enable the anterior teeth to be moved backward into line.

After the extraction of the tooth or teeth it is well to draw backward, by easy stages, the teeth on either side anterior to the space, to and including the cuspids. The subsequent drawing in of the four incisors will then be a comparatively

easy matter. In many cases, if the posterior teeth were used as anchorages for the inward movement of six or ten anterior teeth, they would be more likely to move forward than to cause the anterior ones to be forced backward, on account of the disparity of resistance.

A number of methods for moving backward the cuspid and bicuspid teeth are described on pp. 141 to 144. A simple plan for drawing in the four superior incisors, is shown in Fig. 147. Platinum bands are fitted to the laterals, and to their labial portions are soldered extensions of gold, to cover and rest upon the labial surfaces of the adjoining centrals. A plain rubber plate is also made to cover the palate, with a gold hook inserted in its center. The bands being cemented in place, rubber rings are slipped under the extensions and carried to a point between the centrals and laterals, where they are drawn in and over the gold hook in the plate. By their contraction, all four of the incisors are drawn inward while but two of them are banded.

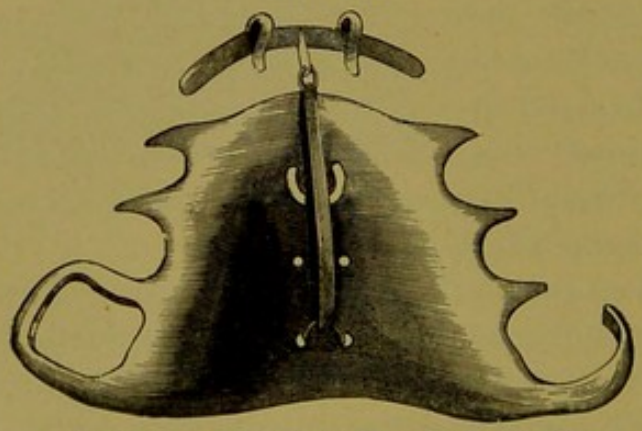
FIG. 147.



Author's Device for Retracting the Superior Incisors.

A plan differing somewhat from the one just described, is that of Dr. Kingsley's, illustrated in Fig. 148. The band overlying the incisors is of gold, and

FIG. 148.



Gold Bar and Vulcanite Plate for Retraction. (Kingsley.)

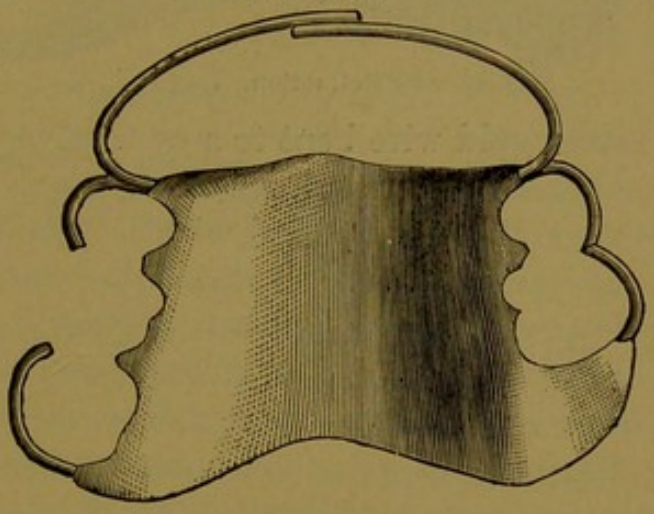
has hooks soldered to the upper edge to prevent its slipping up to the gum. It is also fitted with a thin strip of gold to pass between the centrals, the free end of which is connected with the center of a vulcanite plate by means of a ring cut from rubber tubing. This rubber ring is made fast to the plate either by a ligature or by slipping it into a horse-shoe slot cut in the plate for the purpose.

In many cases the elasticity of rubber does not provide sufficient force to move backward the anterior teeth. In such event advantage may be taken of the superior power furnished by piano-wire. An excellent plan for arranging and anchoring such wires is furnished by Dr. Wadsworth.* The appliance is constructed after the method of Dr. Jackson, and is illustrated by Fig. 149.

In his description, Dr. Wadsworth says:—

"A vulcanite plate was fitted to the roof of the mouth, and well cut away from the lingual surfaces of the front teeth. Piano-wire springs of No. 21 gauge were vulcanized into the plate, passing through the spaces made by the removal of the first bicuspids, and following around from each side of the labial surfaces of the cuspids and incisors were made to pass each other at the median line. These springs were bent to give the required pressure on the teeth to be moved and the pressure increased by bending the springs from time to time as the teeth were moved inward. The appliance was held in position by clasps made from No. 20 piano-wire fitting the bicuspids and molars, as seen in cut.

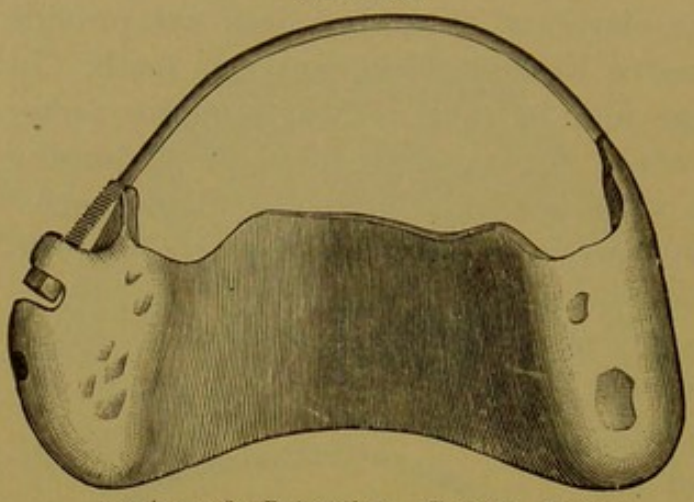
FIG. 149.



Dental Cosmos, Vol. XXXIII., p. 30.

"The patient was seen once or twice each week to increase the pressure as required and the deformity entirely corrected in three months and a half. The appliance was worn continuously, could easily be removed for cleansing and replaced by the patient, and caused no pain or inconvenience whatever."

FIG. 150.



Appliance for Retraction. (Tomes.) (Perry.)

The direct and forcible action of the screw may be conveniently brought into play by means of the device shown in Fig. 150. It is a vulcanite plate covering the arch and encasing the molars, to which is attached a half-round gold wire bent to a curve and long enough to extend along the outer surfaces of the teeth from molar to molar. One end of this curved wire is permanently attached to the vulcanite plate while the other terminates in a threaded wire, which engages with a gold nut playing in a slotted recess of the plate on the opposite side. Turning the nut shortens the bar and draws the teeth inward.

Another appliance operating upon the same principle but possessing additional valuable features is shown in Fig. 151. It was devised by Dr. Louis Jack many years ago and is employed by him not only for moving the incisor teeth outward or inward but for the purpose of aligning any of the anterior teeth.

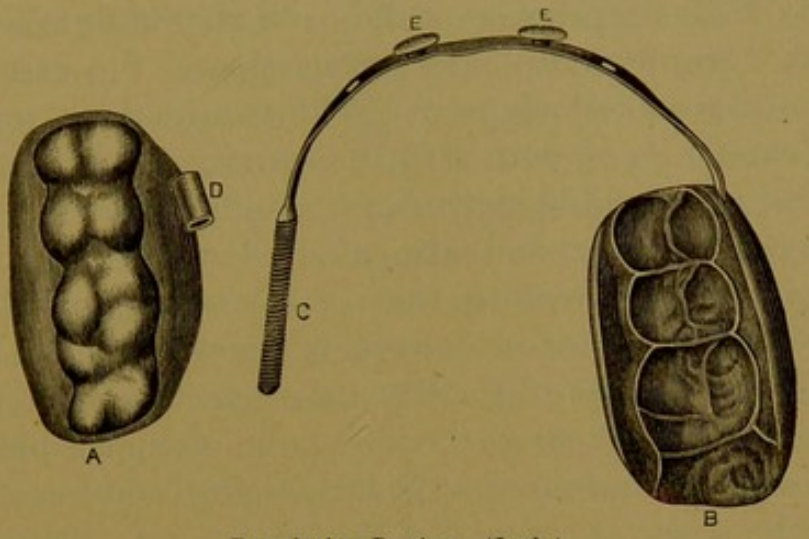
Dr. Jack described the appliance as follows:*—"It is composed of two pieces of vulcanite joined by a gold band or wire. To give the shoes strength and to enable the patient to masticate upon them, they are surfaced with gold swaged

*International Dental Journal, July, 1893.

to the form of the ends of the teeth. The gold facings are vulcanized to the shoes in their proper places.

"These bases of support for the movement of the teeth are connected by a narrow band of springy gold, one end of the bar being secured to one of the shoes, the other end being attached to the opposite shoe by a male screw fitting in a screw-cut tube or, with proper precautions, vulcanized into a projection on the outer plate of the shoe.

FIG. 151.



Regulating Device. (Jack.)

A. Occlusal surface of the movable shoe, showing gold facing.
B. Under surface of fixed shoe.
C. Screw operating in threaded cylinder D.
E. Cleats for attachment of rubber bands.

"The reason for this plan is that by turning the free end of the appliance the bar may be reduced or increased in length. If in any given arch a tooth or more is projecting and others are depressed, the bar is brought into contact with the most prominent tooth, and a piece of elastic rubber is placed between this point of contact, at the same time a rubber ring is carried over each of the teeth which are within the arch and is drawn through a hole opposite the tooth and extended to a button. On the next day the bar is screwed up enough to be again in contact, when a new pressure may be made or the tooth is rested, as the conditions require. If the depressed teeth are sore, they may be rested by tying through the same channel as the ring had passed. I remove these plates daily, each time making a gain in the progress. It is important to make this daily change for the sake of

cleanliness, the patient brushing the teeth while the further preparations are being made.

"Rotation may also be conducted by the various attachments made for that purpose by connecting the rubber band to the attachment, and many modifications of this simple description will occur to meet the exigencies connected with the alignment of the teeth.

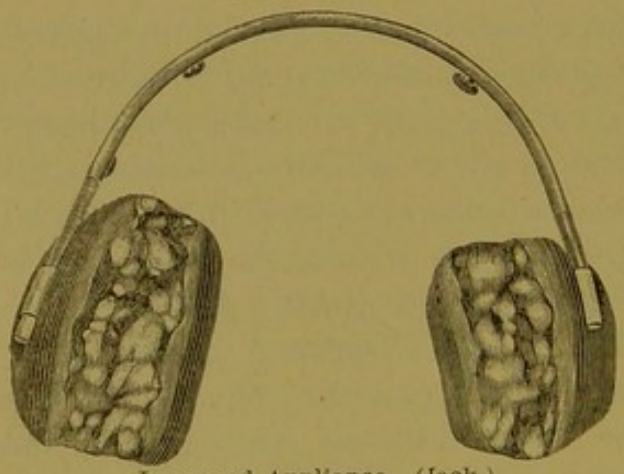
"The impression of the teeth should be taken with plaster.

"Some preliminary preparation of the cast is required to enable these shoes to hold firmly their position. They should go on with a little springiness. The cast is trimmed with a suitable instrument to take a shaving from the teeth at the neck, and also a shallow groove should in most instances be made in the plaster, at the gingival margin. The proper amount of cutting is quickly gained by experience.

"The only originality in connection with this appliance is the division of the old form of upper plate which was used to separate interlocked arches, and to connect these by the screw at one end of the bar."

More recently Dr. Jack has modified his appliance by having the bow wire connected with each shoe by means of threaded tubes. This improvement increases its range of applicability. It is shown in Fig. 152.

FIG. 152.



Improved Appliance. (Jack.)

When still greater power is demanded, as in cases where it is desired to draw the six anterior teeth inward by one operation, or where the incisors do not yield readily to any power that can be applied within the mouth, anchorage for resistance must be obtained outside. Dr. Kingsley, we believe, was the first to suggest and

utilize the back of the head as an anchorage for appliances intended to produce movements of the teeth. Illustrations of a fixture of this character will be found in his work, pp. 133 and 134.

Dr. Farrar also devised an apparatus for the same purpose, but it is somewhat complicated in its construction and manner of adjustment.

One of the simplest devices of this character, is that of Prof. C. L. Goddard.* In describing the construction and use of his appliance, he says: "On a cast of the superior incisors a small sheet of wax was placed, covering the labial surfaces, cutting edges and part of the lingual surfaces. In the anterior surface of this wax plate, a steel wire was imbedded, curved to conform to the arch, and extending laterally about one inch and a half on each side. The ends of this wire were bent in the form of hooks. The wax plate and wire were then imbedded in a flask by bending the ends of the wire sufficiently to allow them accommodation inside of the flask. By the methods usually employed in vulcanite work, a plate was thus made of black rubber with the wire attached, as shown in Fig. 153.

FIG. 153.

Goddard's Steel and Vulcanite Appliance for Retraction.

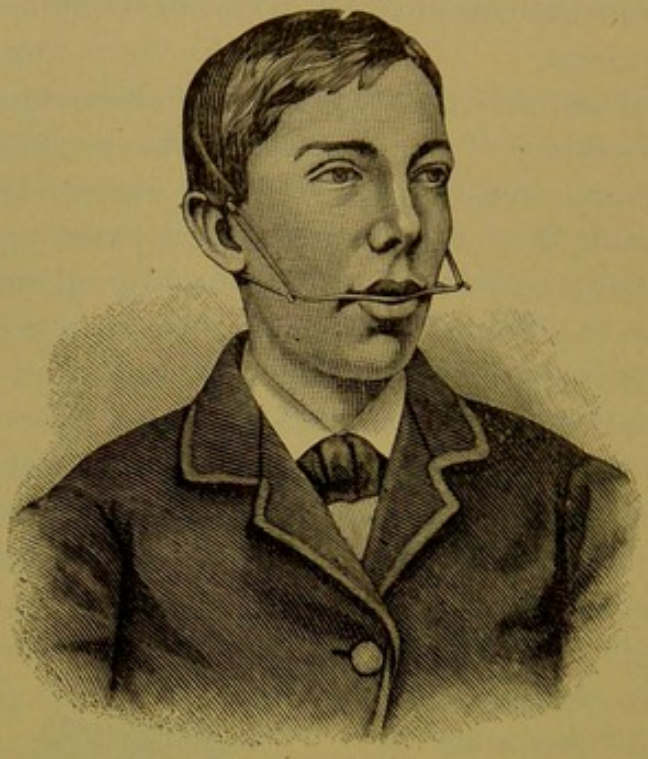
"When placed on the patient's teeth, the ends of the wires projected from the corners of the mouth on each side far enough to permit elastic bands to connect them with a cloth cap on the patient's head without touching the cheeks.

"The cap was so shaped that the elastic could be attached to it in two places on each side, one above and one below the ear, by means of dress hooks sewed to the cap at these points. Round silk-covered elastic cord was used, and the direction of the force could be varied by using a greater

*Annual of the Universal Medical Sciences, for 1888, Vol. III., pp. 547–551. F. A. Davis, Philadelphia, publisher.

number of strands above or below the ear, according to the requirements of the case. The amount of force was easily varied by shortening or lengthening these cords. Fig. 154 shows the appliance in position.

Fig. 154.



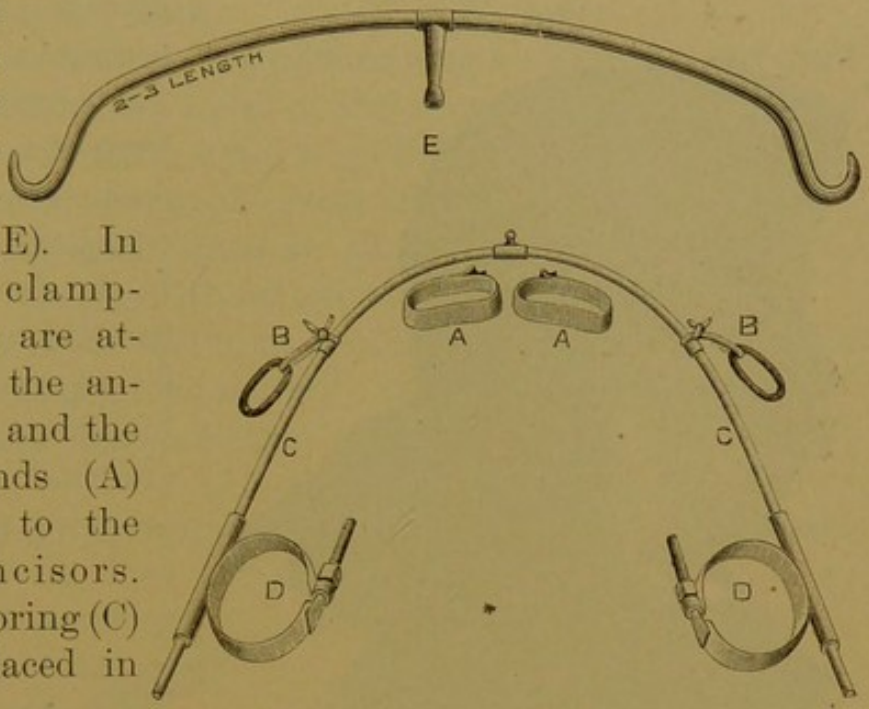
Appliance in Position. (Goddard.)

"This appliance was worn at night only, and the teeth were soon moved back to the desired position. The inferior incisors striking the bases of the superior ones, were moved backward with them. After the teeth were in proper position, the tension of the elastic cord was slightly lessened and the appliance worn at night for a few months as a retaining appliance, until the teeth became firm.

For the reduction of superior protrusion, Prof. Angle's appliance as shown in Fig. 155, commends itself for simplicity and efficiency. It consists of anchor bands (D) for the molar teeth, with long tubes soldered to their buccal surfaces to receive the wire bow spring (C) which rests in front in notched projections upon bands (A) cemented to the central

incisors. At the center of the bow-spring is soldered a short tube, having upon its labial surface a rounded projection to receive the standard (cupped at its free end) of the long traction bar (E). In use, the clamp-bands (D) are attached to the anchor teeth and the plain bands (A) cemented to the central incisors. The bow-spring (C) is now placed in position.

Fig. 155.



Occipital resistance is obtained by means of a netted cap fastened to a circle of wire fitted to the head, to which are attached rubber bands. When the cupped standard of the traction bar has been placed over the central spur of the bow-spring, the rubber bands of the cap are drawn forward and looped over the curved ends of the traction bar, as shown in Fig. 156. This cap, traction bar and rubber bands are worn only at night on account of their conspicuousness.

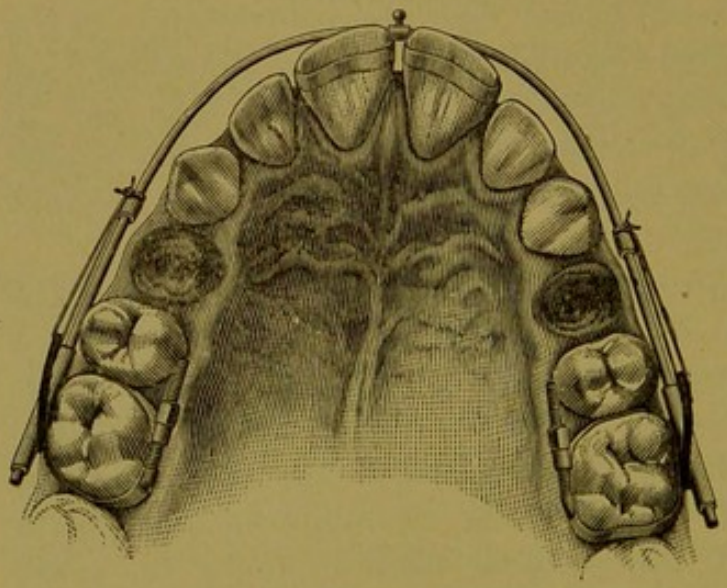
During the day, rubber rings (B) are caught over the tubes on the molar bands and secured by ligature to projections on the bow-spring in the region of the cuspid teeth. The appliance in position, as worn during the day, is illustrated by Fig. 157. After reduction of anterior protrusion we are met with the difficulty of retaining the results gained. Although the posterior teeth in many cases will not furnish the resistance necessary for drawing the anterior

teeth inward, they will usually answer perfectly for retaining them afterward. Attachment can be made to them either by means of a rubber plate covering the roof of the mouth and extending around their distal surfaces in the form of a clasp, or by means of metal bands cemented to them. In the former case a small round or half round gold wire may be made to pass around the arch, touching the regular teeth on their labial surfaces, and be attached at each end to the rubber plate at convenient points, as where teeth have been extracted. In the latter case a similar wire may be soldered to thre molar bands, or the bands may have tubes soldered to their buccal surfaces and the wire, threaded at the extremities, passed through these and re-

FIG. 156.

Night Appliance. (Angle.)

FIG. 157.



Day Appliance. (Angle.)

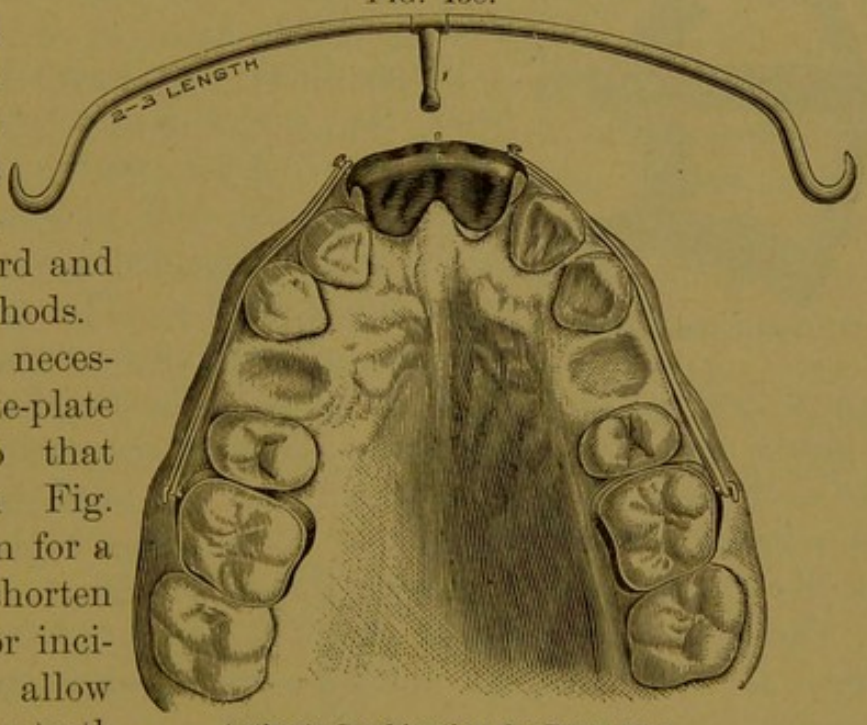
tained by means of nuts operating upon them. In either case the retaining wire should have short gold clips attached to it in front to engage with the cutting edges of at least two of the incisor teeth.

Where it is desired to avoid having a retaining wire pass entirely around the front of the arch, a rubber retaining plate may be made with a gold T passing between the centrals and long enough to rest upon all four of the incisors. Holding these teeth firmly in place will also keep the cuspids in line through lateral pressure.

In all cases the retaining appliance should be worn for a year or more, until we are fully satisfied that the teeth are firm in their new positions and manifest no tendency to change.

The author's preferred plan for employing occipital resistance for retraction, differs in certain particulars from both the Goddard and Angle methods.

FIG. 158.



Author's Combination for Retraction.

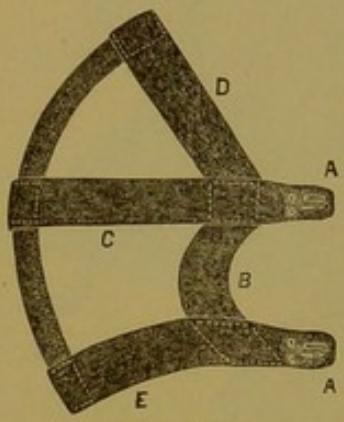
When necessary, a bite-plate similar to that shown in Fig. 146 is worn for a year to shorten the inferior incisors and allow the posterior teeth both above and below to elongate. A thin silver saddle is then swaged to cover the crowns of the central incisors, to which on the labial surface near the extremities are soldered two headed pins taken from block teeth. In the center of

the saddle on the same surface, a short pin or post of iridio-platinum is also inserted to engage with the Angle traction-bar, as shown in Fig. 158.

The molars are fitted with platinum bands to which hooks are attached on the buccal surface. The skull-cap is made in skeleton form of inch-wide strips of sheep-skin leather sewed together, using the undyed skin for patients with light-colored hair, and dark leather for brunettes. A pattern of paper strips is first made and fitted to the head, and from this the one of leather is formed.

Fig. 159 shows one side of the cap with the manner of uniting the strips where they pass around the ear. In use, the saddle is placed in position and the headed pins upon it are connected with the hooks on the molar bands by means of thin rings cut from rubber tubing.

Fig. 159.



Author's Skull-Cap.

The skull-cap is next placed upon the head; the cupped post of the traction bar adjusted to the central pin on the saddle, and the ends of this bar connected with the hooks on the skull-cap by means of elastics. The elastics used are the ordinary flat rubber bands, about half an inch wide, cut to suitable lengths and perforated near their extremities. The entire appliance is to be worn from the close of school each day until the opening of school on the following one, but during school hours the skull-cap and traction bar are dispensed with.

Thus, for sixteen hours out of the twenty-four constant force is being exerted upon the teeth, while during the remaining eight hours the delicate elastic bands retain the advancement made.

After correction, the teeth should be retained in position for a year by constantly wearing the silver saddle connected with the molar bands by elastic rubber rings.

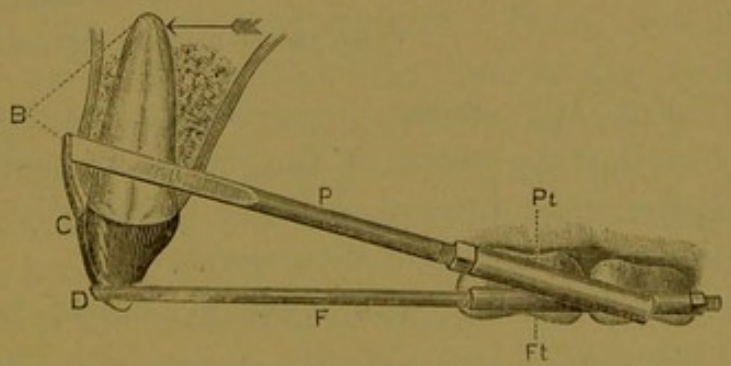
Movement of Roots of Teeth Independently of Crown Movement.

As explained in Part I., Chapter VIII., the movement of the crown of a tooth in one direction is, by ordinary methods, accompanied by the movement of the root in an opposite one, some portion of the alveolus forming a fulcrum about which the movement takes place. Usually these two opposite movements are desired and required by the conditions of the case.

At times, however, it is desired to move the root without changing the position of the occlusal portion of the crown, while in other cases it is desirable to move both crown and root in the same direction, in order to produce proper harmony of the features.

Attempts have been made from time to time, with different appliances, to produce these latter movements, but they were not satisfactory in character until in 1893, Prof. C. S. Case devised a plan by which it might be successfully accomplished. It consisted in attaching an extension rod or bar to a band on a tooth and applying force to the free end of this bar instead of to the band on the crown. In this way, he not only obtained increased leverage, but was able to apply his force at a point opposite to the root somewhere near the middle of its length and move it in any direction, provided he held the occlusal edge immovably. In addition to this, by means of his ingenious combination of power-bars, tubes and nuts, if, in the progress of the case, it became necessary to move the crown much or

FIG. 160.



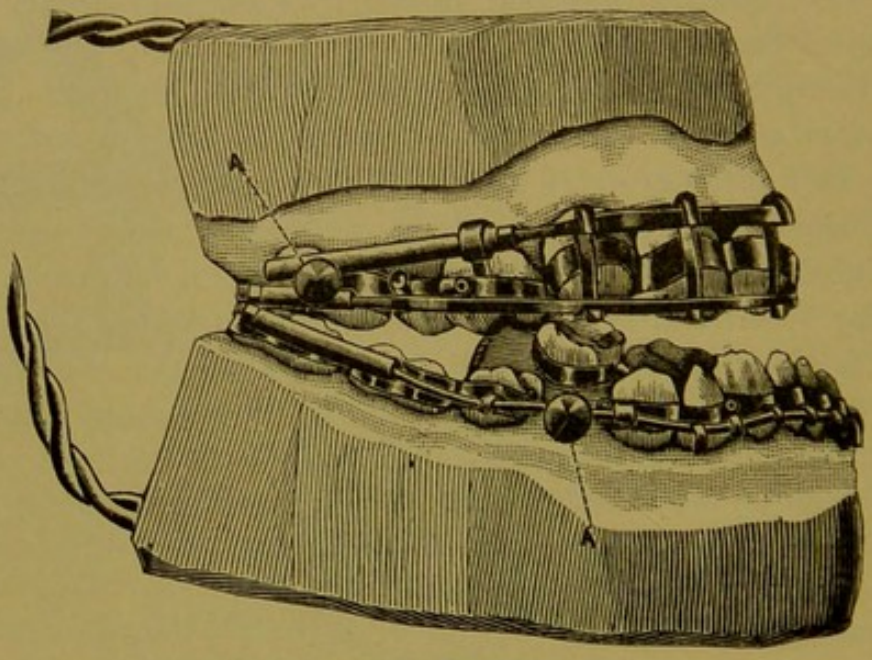
Increased Leverage for Moving Root. (Case.)

little, it was readily accomplished at the will of the operator. The device and the philosophy of its action will be readily understood by an examination of Fig. 160.

The cut shows the device as arranged for moving the root outward independently of the crown. When it is desired to move the root in the opposite direction, the power-bar is arranged to rest against the outer side of the extension rod, and the nuts are made to operate against the opposite ends of the tubes from those shown in the illustration.

While a single root or crown may be moved by this plan, it is especially designed to move a number *en masse*, thus changing the facial expression of the parts involved in any manner desired.

FIG. 161.



Case's Device for Root Movement.

Fig. 161 shows the complete appliance in position for moving the roots of the upper incisors outward and the lower ones inward, without materially changing the position or occlusion of the crowns.

In describing the construction of his appliance, Prof. Case says: *

* *Dental Cosmos*, Vol. XXXVII., p. 917, *et seq.*

"For material for regulating appliances I prefer German silver, not because of its inexpensiveness, but because much experience with all other metals has taught me that none possess the same favorable qualities for this work.

"The bands which surround the teeth should be wide and thin. If No. 10 B. & S. gauge wire is rolled to four, or four and a half thousandths of an inch, it will usually be about the right width. This banding material should be drawn firmly around the natural teeth, the ends bent sharply to a right-angle for the joint. When these are soldered, the joint should project about a thirty-second of an inch, with its sharp corners clipped. Then the bands should be carefully fitted and burnished to the teeth with the joints a little to one side of the center of their anterior faces, to allow the upright bar to take its proper position, exactly in the center and parallel with the long axis of the tooth, and also to serve as a strengthening girdle to the attachment. These and other small details may seem unnecessary, and yet, practically, they are of vital importance in the construction and application of the apparatus. It will be remembered that I originally made these upright bars of flattened No. 18 wire, leaving the ends long enough to bend over when in place, and clasp the force bars. The operation of bending the bars was often a difficult and painful one, especially when it became necessary to remove and recement a band.

"For upright bars I now cut pieces from Nos. 15 or 16 wire, about three-fourths of an inch long. These are filed slightly at the middle to receive the band, to which they are firmly soldered in the position described. Then they are bent and filed so as to fit perfectly the face of the tooth against which they are to rest. They should also follow the curve of the gum, nearly touching it, and extend above its free margin about one-fourth of an inch. The perfecting of these can only be accomplished at the chair. Finally the bar is shaped with a file according to whether force is to be applied in an anterior or a posterior direction.

"I will first describe the method of procedure for cases which require a forward movement of the roots. In cases of this character I have never found it necessary to apply force to other roots than those of the incisors. The cuspids are usually retarded from taking their positions of alignment by the posterior position of the incisors, and are frequently so prominent that it first becomes necessary to force the crowns of the incisors forward with jack-screws or otherwise before the contouring apparatus can be effectively placed.

"Usually in those conditions when the cuspids interfere, the upper ends of the upright bars can be at first ligated to the power bar, and thus the incisors forced forward until the power bar can be slipped into its proper position, which, as will be described, is always back of the upper end of the upright bars, against which it presses for the purpose of exerting force as high as possible upon the roots to be moved.

"The posterior surface of that portion of the upright bars which stands in front of the gum is filed flat, so that their antero-posterior thickness tapers to one-half their original diameter at the ends, where they serve as rests for the power bar.

"The anterior surfaces of the ends are rounded and polished to a thin edge. These ends should not extend above the upper edge of the power bar, unless it seems necessary to bend them at the extreme end to form a catch to prevent the power bar from sliding up.

"The lower ends are grooved with a small round file to receive the fulcrum bar, which is a wire (No. 22 or 20), threaded only at one end in the No. 12 or 11 hole of the Martin screw-plate, the other end being held in place by bending it back after passing it through the lower anchorage tube.

"The power bar should be made with the greatest care, in order that it be of the required rigidity and strength. Extra hard German silver wire, No. 10, should be drawn

without annealing to Nos. 13 to 16—the size being regulated by the probable power necessary, and also by the distance from points of attachment and application. In other words —when the anterior end of the anchorage tube (*Pt*, Fig. 160) at which the nut works is even with the bicuspids or at no great distance from the points of applying the force, less rigidity of the bar will be requisite; and again, for very young patients or where little power will be needed for the required movements. Ordinarily, however, No. 13 will not be found too large.

"When it has been drawn to the proper size or selected and cut about the right length, that portion which is to extend between the right and left first bicuspids should be flattened in the rollers to about one-half its diameter. Then it should be bent so as to conform to the shape of the gum along the line where it is to rest. After bending closely over the cuspids, it should extend straight back into the tubes, into which its threaded ends should pass from one-half to three-fourths of an inch.

"For more complete direction in the proper method of cutting a screw, making drills, taps, and nuts, I refer you to other writings where I have fully described the process.

"The construction of the anchorage attachment which now remains to be described is of the greatest importance to the ease and accuracy of its application and subsequent usefulness.

"Two molars, or the first molar and a bicuspid, and sometimes all three, should be selected for the anchorage teeth. When these are accurately fitted with wide bands, an impression in compound, of one side at a time, including the cuspids, should be taken. The bands should then be removed from the teeth without bending, and carefully placed in their proper positions in the impression, which should be filled with Teague's or other investing compounds. You now have the bands upon a small model that will hold them firmly in their proper relative positions during all the soldering process.

"As the position and mechanical perfection of the power tube (*Pt*, Fig. 160) is of paramount importance, it should receive first attention.

"Select a strong tube one-half or three-fourths of an inch long, that loosely fits the threaded end of the bar. Its anterior end should be placed so that the nut will work freely upon the bar without impingement upon band, tooth, or gum, and it should take a direction that points exactly to that place upon the cuspid over which the power bar is to extend. In order to strictly observe this important direction, it usually becomes necessary to raise one or the other end of the tube from the bands by the intervention of lifts. It is often convenient to rest its posterior end upon the lever tube, its sharp projecting edges being rounded so as not to irritate the cheek.

"The lever tube (*Ft*, Fig. 160) should also loosely fit its bar or wire, and be soldered directly to the bands, which it firmly unites, and thus serves to give statical strength to the anchorage. Their direction is not as material as that of the power tubes, because of the smallness and flexibility of the lever wire. Their posterior ends should project sufficiently free from the other parts to admit of the working of the nut. And in those instances where reciprocating rubber bands are to extend to a lower appliance—the advantage of which has been explained elsewhere—I allow these tubes to project for that purpose, finding them much more convenient than the buttons which I formerly used.

"The tubes now being fitted with their joints turned toward the bands, they are attached with an abundance of silver solder, the bands also being united along their approximal surfaces.

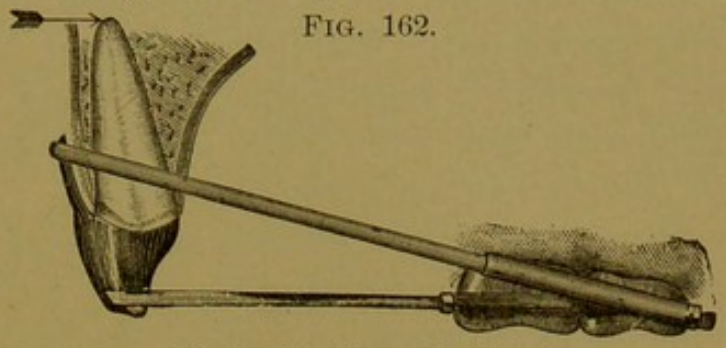
"All the parts which have undergone the soldering process are now boiled in sulfuric acid to remove the borax and oxid, after which the entire apparatus is polished and heavily gold-plated.

"The teeth being properly separated with wax tape, the anchorage appliances should first be fitted to place in the

mouth, and the cement allowed to harden before proceeding further, to prevent dislodgement by the force necessary in placing the power bar in position, especially as it often becomes necessary to remove and rebend the bar several times in the final perfecting of its shape.

"With the anchorage appliances and power bar in place, the bands for the anterior teeth may now be fitted and cemented, allowing the upper ends of the upright bars to rest in front of the power bar. Finally, the lever bar is placed, and the contouring apparatus is ready to commence the application of force at the next sitting.

FIG. 162.



Moving Root Inward. (Case.)

"An apparatus for moving the roots of the anterior teeth in a posterior direction is in the main constructed quite similarly. (See Fig. 162.) The power bar now being used for traction force, the same rigidity is not as necessary as in the other apparatus. I find, therefore, that a No. 16 wire, not flattened in front, is of sufficient size.

"The other, or lever bar, the force of which acts in the opposite direction to prevent the occluding ends of the teeth from being drawn back, should be as large as No. 18. It should be flattened in the same manner described for the power bar. The upper ends of the upright bars are grooved on their anterior surfaces to form a rest for the power bar; while a shoulder is filed on the posterior surface of the lower ends, which forms a slot, when in place, for the flattened lever bar to rest.

"It being understood with this apparatus that the power bar nuts work at the posterior ends of the tubes, while those of the lever bar work at the anterior ends. Proper provisions for this arrangement should be made when constructing the anchorage appliances."

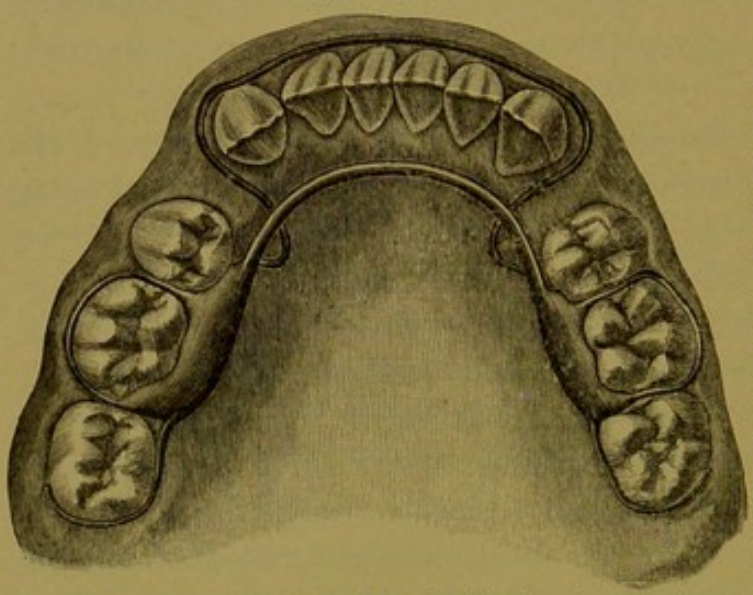
CHAPTER VIII.

PROTRUSION OF THE LOWER JAW.

This condition, one of the most unsightly of dental deformities, giving to the individual a rather inhuman expression and interfering greatly with speech and mastication, is quite frequently met with. The causes probably responsible for its inducement are given on p. 25.

When the deformity is slight it may be corrected, or at least modified, by pressing the lower incisors inward and the upper ones outward; but where the case is pronounced, there seems to be no remedy for it but the retraction of the entire inferior maxilla.

FIG. 163.



Retraction of Inferior Anterior Teeth. (Jackson.)

Appliances for moving the superior teeth outward, are shown in Chapter VI., of this Part. For retracting the inferior incisors, Dr. Jackson has illustrated two devices,* constructed according to his method, both of which have the merit of simplicity and effectiveness. The first of these, Fig. 163, he describes as follows:

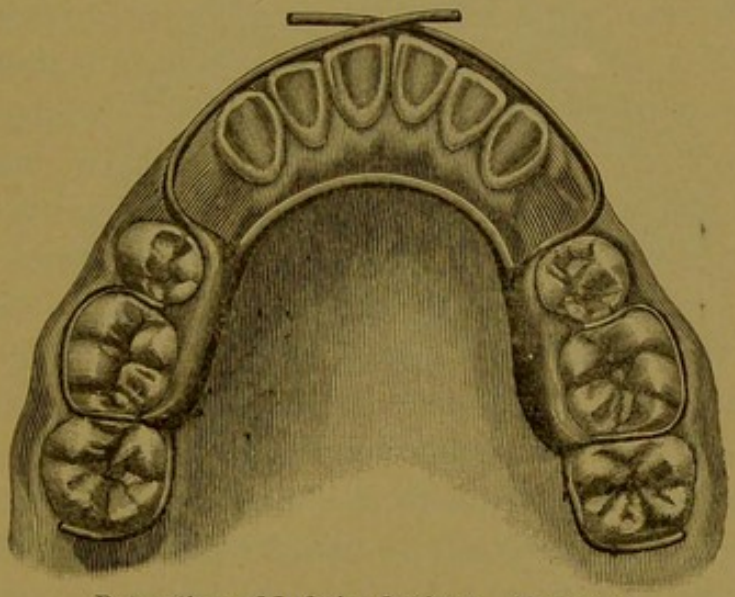
"The base-wire No. 13 is bent into a semi-circle to conform to the curve of the arch with the ends anchored with 'crib-attachments' to the first molars, and wire clasps extending backward to the distal side of the second molars, and if

* Items of Interest. June, '97, pp. 431, 432.

all of the teeth are erupted, a crib attachment should be placed over the second bicuspid and another over the second molar, the base-wire being placed back of the incisors a sufficient distance to permit of their movement. A spring wire, about No. 19, is shaped to conform to the labial side of the incisors and cuspids near the gum, passing close to the distal side of the latter, through the space caused by the removals of the bicuspids and bent into the form of a loop, between the base-wire and the gum, about one-fourth of an inch, with the ends of the springs soldered to the 'crib-attachments' with the ends of the base-wire. The desired pressure is caused by bending the sides of the loops toward one another from time to time.

"If there are no spaces between the teeth, the curves of the spring should be such as to permit a narrow space between it and the distal surface of the cuspids, to prevent the teeth from becoming wedged together during movement. Closing the loops in the spring in the manner described, causes more inward pressure on the cuspids than incisors, owing to the natural elasticity of the part of the spring that passes in front of them. With this arrangement the cuspids begin to move before the incisors, which lessens the danger of the forward movement of the teeth used for anchorage, it being understood that after teeth have commenced to move less force is required to continue their movement.

FIG. 164.



Retraction of Inferior Incisors. (Jackson.)

"In Fig. 164 is illustrated another form of appliance

which has been used satisfactorily for moving inward all of the incisors and cuspids at one time, and which is equally applicable for moving a less number.

"It is made with a base-wire, anchored in the same manner as the previous one, it being arranged back of the teeth a sufficient distance to admit of their moving inward.

"Long springs are attached to the base-wire on the inside, passing to the outside through the spaces caused by the extraction of the first bicuspids, and then curved forward to rest upon the labial sides of the teeth, each passing beyond the median line as shown in the illustration.

"The variation of pressure is caused by shaping the springs so as to impinge upon the portion of the arch that it is desired to move, usually first causing pressure at the median line. Where retraction of the entire maxilla is demanded, it may best be accomplished by using some form of skull cap, and connecting it with a padded chin piece by means of strong rubber bands. The persistent contraction of the rubber will, in a greater or less time, dependent largely upon the extent of the deformity and the age of the patient, bring about the desired change.

"In the accomplishment of this retraction, it was formerly supposed to be brought about by a change effected at the angle of the jaw; but the more plausible hypothesis is the one first advanced by Dr. Geo. S. Allen, namely: That the pressure applied to the mental region causes resorption of the posterior wall of the glenoid cavity, thus permitting the condyles to recede and articulate somewhat posteriorly to their former position. This theory as to the physiological change brought about, is supported by the fact that an alteration of form in the gleniod cavity is more readily accomplished by resorption, than a bending of the maxilla at its strongest point."

An interesting case of retraction of the lower jaw was brought before the Odontological Society of New York, in 1878, by Dr. Allen. I quote important points from his

description: "As will be seen from the photograph (Fig. 165), taken at the time she was wearing this apparatus, it consists of two parts. For the lower part, I made a brass plate to fit the chin, having arms with hooked ends reaching to a point just below the point of the chin. These arms were arranged in such a way that the distance between them could be altered at will, by simply pressing them apart or together. The upper part consisted of a simple network going over the head and having two hooks on each side, one hook being above and the other below the ear. When this apparatus was completed and in use, there were four ligatures of ordinary elastic rubber pulling in such a way as to force the lower jaw almost directly backward. The work proceeded very rapidly, so that at the end of two months the irregularity was almost entirely cured. I see no reason why, in all such cases, either this or similar methods of procedure should not be adopted. I should certainly, if any similar cases presented hereafter, even at twelve or thirteen years of age, before attempting any other procedure, try this first and thoroughly."

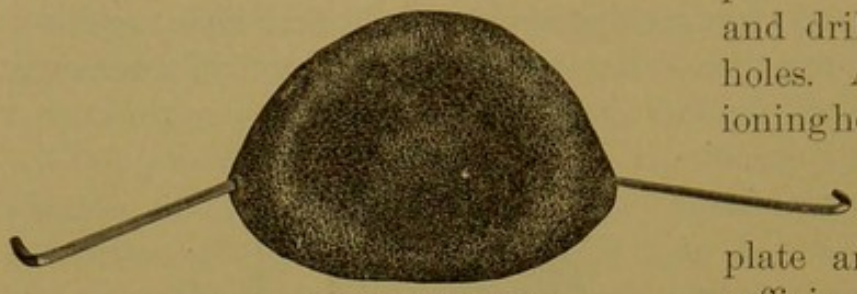
FIG. 165.

Allen's Device for Retraction of Lower Jaw.

In forming the chin-piece for cases of this character the author is accustomed to take a plaster impression of the chin and from this make a model. The model is then overlaid with a piece of trial-plate wax, from which, after being

varnished, a mould in sand is obtained and a die and counterdie made. Between these a piece of soft and heavy brass plate is struck up and drilled full of holes. After fashioning heavy piano wires to cross the plate and extend sufficiently beyond to form hooks, they are soft-soldered to the brass plate and the latter covered with black sheep-skin with a thick layer of cotton batting laid between the two. The enlarged size of the chin piece will admit of this. The piece thus padded will fit the chin and be soft enough to prevent pain when pressure is brought to bear upon it. It is shown in Fig. 165. The skull-cap to be worn in connection with this chin-piece is shown in Fig. 159.

FIG. 165.



Author's Chin-piece.

FIG. 166.

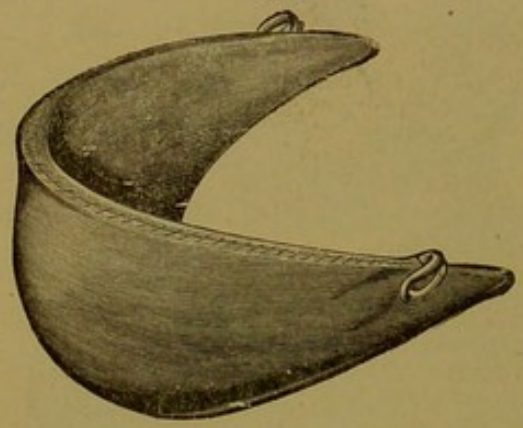
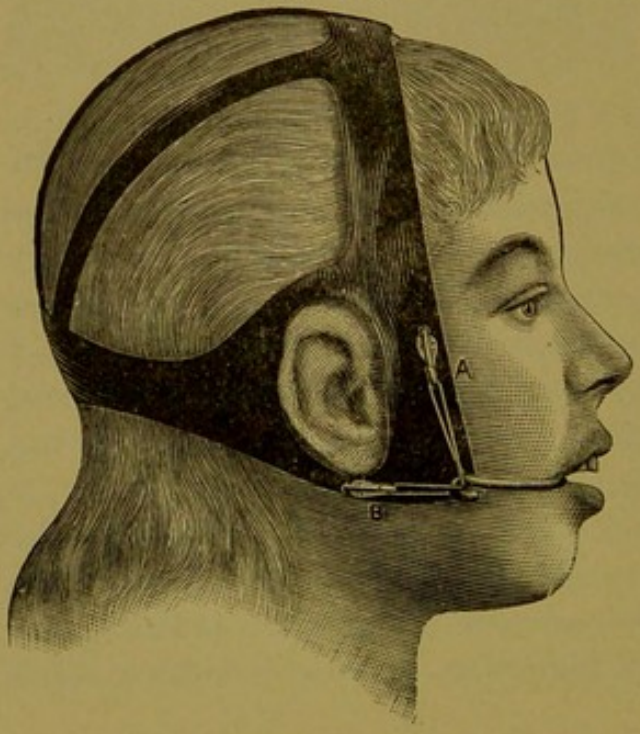


FIG. 167.



A chin-piece devised and used by Dr. Kingsley* is shown in Fig. 166. It is made of "sheet copper (stiffened around the edge with non-elastic steel wire accurately fitted to

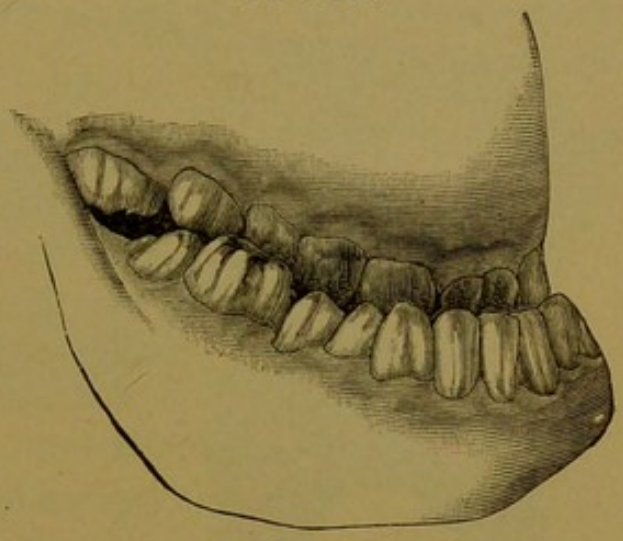
Dental Cosmos, Vol. XXXIV., p. 19.

a plaster cast of the chin) padded, and covered with leather."

The skeleton skull-cap, used by Dr. K., is made of leather, and is shown in position in Fig. 167.

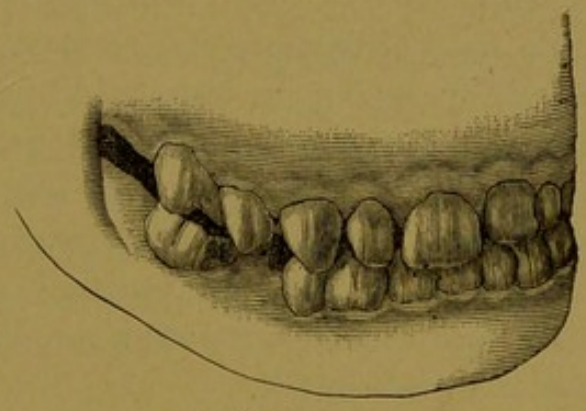
Dr. Winner, of Wilmington, Del., furnishes models and description of a case somewhat similar to that of Dr. Allen, (Figs. 168 and 169.) In this case, the patient was a boy fourteen years of age, tall, slender, possessing good general health, but only fair physical strength. The models show that there was a bicuspid lacking on each side above, while below there still remained two temporary molars. He stated that he had never had any teeth extracted by a dentist, so it is probable that the two bicuspids were never erupted. The superior centrals were considerably worn away on their incisal edges and labial surfaces by occlusion with the lower ones. After extracting the deciduous molars below, a plate was made covering the upper posterior teeth, so arranged that in addition to furnishing a masticating surface it acted as an inclined plane in helping the lower jaw to move backward. From first to last he wore an occipito-

FIG. 168.



Inferior Protrusion. (Winner.)

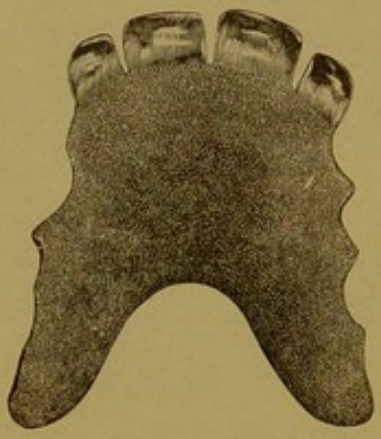
FIG. 169.



Case Corrected.

mental sling, as illustrated in Garretson's Oral Surgery, increasing the tension from slight at first to as tight as could be borne without too great discomfort. At the end of nine weeks the articulation was normal, but the sling was worn for several weeks longer, without increased tension, to retain the satisfactory result secured. The wearing of a plate in the upper jaw arranged with an inclined plane, as described, will materially assist in forcing the lower jaw backward.

FIG. 170.



Author's Inclined-plane Plate.

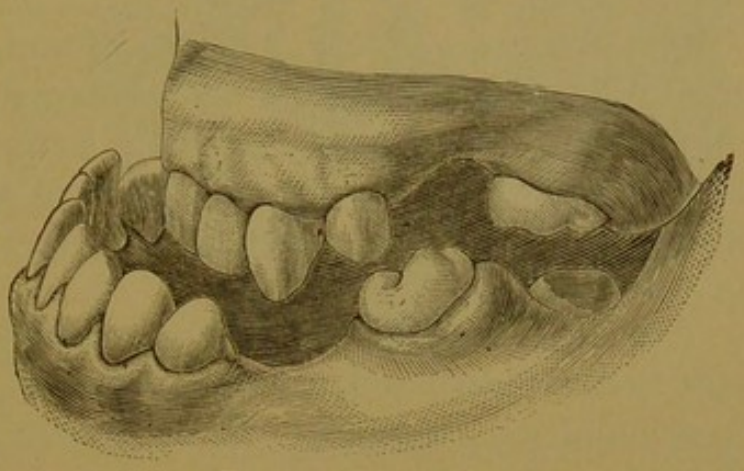
Fig. 170 represents a form of plate used by the author in forcing the inferior incisors inward, and the superior ones slightly outward in cases where both movements are desired. It is constructed of vulcanite and has inserted in its anterior portion pieces of platinous or spring gold plate directly opposite the incisors, and arranged to rest against their lingual surfaces and extend below their incisal edges.

To hold this plate in place and resist the leverage produced by biting on the gold projections a molar on each side was fitted with a Magill band, to the linqual side of which was soldered an oval lug or projection. When the plate was inserted it was sprung up past these lugs, and thus securely held in position. The patient by a slight, dexterous movement could remove the plate for cleansing and then reinsert it.

Fig. 171 illustrates the most pronounced case of this class of deformities the writer has ever met with. The patient was a man of about forty years of age and was brought by a neighboring dentist for consultation as to whether anything could be done to remedy the defect. The lower jaw was very large in all its aspects, while the upper was corres-

pondingly small. Although the lower incisors inclined decidedly inward, the distance from the incisal edge of the lower incisors to the incisal edge of the upper in a horizontal line was a little over half an inch. From the upper jaw there were missing the right lateral, second bicuspid and first molar; while on the left side the second bicuspid and two molars were absent. In the lower jaw, the patient had lost two molars and a bicuspid on left side, and the first molar on the right. All of the teeth in the upper jaw passed inside of the lower, except the first bicuspids, whose external cusps occluded slightly with the anterior lingual cusps of the opposite molars below.

FIG. 171.



Excessive Prognathism.

The advanced age of the patient, conjoined with the conditions just described, placed his case beyond surgical remedy and he was so informed. A plate covering and masking the natural teeth above with artificial teeth mounted outside to occlude with the lower ones was suggested, but the idea did not please him, and he concluded to pass the remaining portion of his life as he had the first, so far as his dental apparatus was concerned.

CHAPTER IX.

LACK OF OCCLUSION.

This deformity, while not of common occurrence, is one most difficult of correction. It is characterized by a failure on the part of a number of teeth to occlude, and is not only liable to impart a lisp to the speech of the individual, but also renders the involved teeth entirely useless for purposes of mastication.

The causes responsible for the condition are at best difficult to determine, and vary according to the character and location of the deformity. It may present in three different forms.

1. Where some of the posterior teeth occlude and the anterior ones do not.

2. Where the anterior teeth occlude and the posterior ones do not.

3. Where both anterior and posterior teeth occlude and the intervening side teeth fail to come into contact.

The first may be designated:—

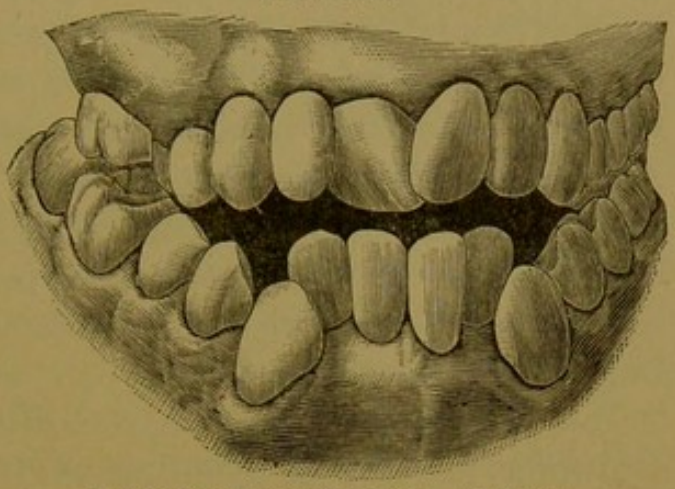
Lack of Anterior Occlusion.—The cause of this form of deformity has been variously attributed to thumb-sucking, to sleeping with the mouth open and to derangement of the articulation caused by ill-advised extraction of some of the posterior teeth; but while all of these are doubtless responsible for the condition in many instances, it is probably more frequently caused either by the lack of alveolar development in the incisor region, or an unaccountable variation in the plane of the alveolar border of the maxilla.

At first glance the incisors have the appearance of being too short in their crowns, but an examination will usually show that they are of normal size and length and that the

process and possibly the maxilla itself is responsible for the shortened appearance.

In most cases it will be found that both arches are normal in form and size, that there is no anteversion or introversion either above or below, and that the superior teeth alone are at fault. Fig. 172 represents a case of this character, in which the condition is complicated with considerable irregularity of both superior and inferior teeth, the model being from the collection of Dr. H. A. Baker.

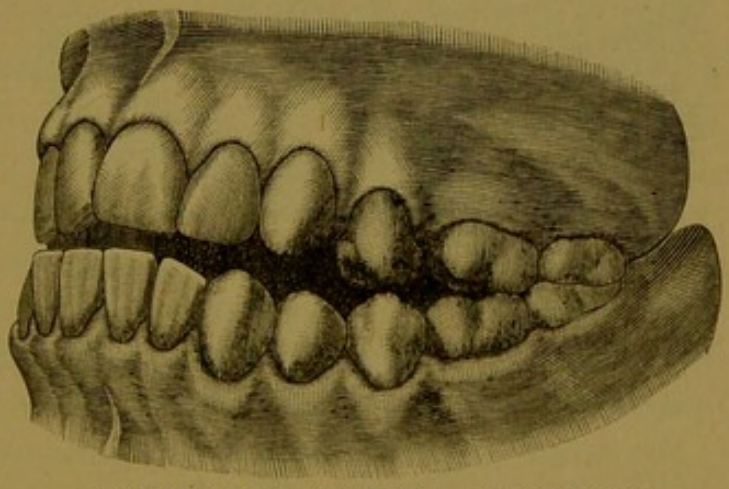
FIG. 172.



Lack of Anterior Occlusion. (Baker.)

A more typical case, in which both arches are normal in size and outline and where there exists a simple inability to effect a closure of the jaws in front, is shown in Fig. 173. The model was sent to the author by Dr. Quattlebaum of Columbia, S. C. The patient was a strong, healthy girl, fifteen years of age, and no cause for the deformity could be discovered. The second molars on each side, above and below, are the only ones that come into contact; and while the first molars and bicuspids are nearly in contact, the anterior teeth are quite wide apart when the jaws are closed.

FIG. 173.



Lack of Anterior Occlusion. (Quattlebaum.)

Two methods of treatment suggest themselves in cases of this character. In aggravated cases, in young subjects, the better plan is to produce pressure upon the anterior portion of the lower jaw by means of a skull-cap, chin-piece and rubber bands, as described and illustrated in the preceding chapter. The only modification in cases like this being that the power should be applied in an almost vertical direction. An apparatus of this character, worn continuously for a few months, would tend to tip the condyles slightly out of their sockets, and allow the latter to be partially filled with new osseous material. The change thus produced would be slow, but the result satisfactory.

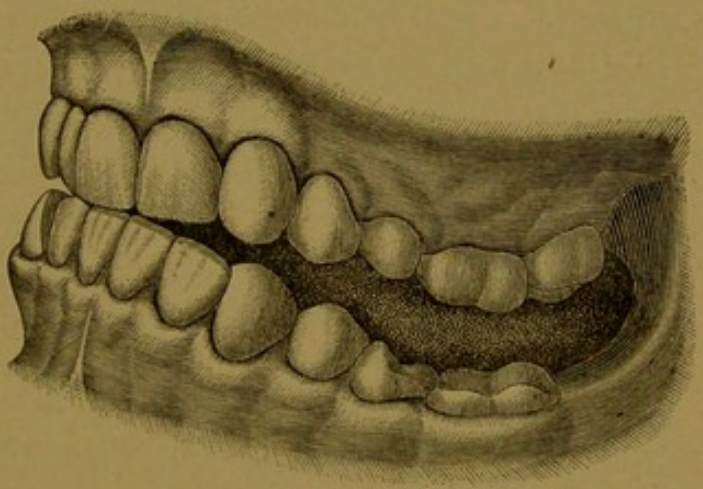
Where the deformity is slight, a simpler and better mode of treatment consists in grinding off the cusps and occluding points of some or all of the posterior teeth in order to shorten the bite and bring the anterior ones more nearly together. Much of this cannot be done without denuding the teeth of their enamel at certain points and exposing the sensitive dentin, but by grinding as much as is possible without causing too great pain and then administering an anæsthetic and continuing the grinding, quite an improvement can be brought about.

The sensitiveness of the exposed dentin may afterward be obtunded by repeated applications of either chloride of zinc, caustic potash or nitrate of silver. Where this will not avail sufficiently, it may be advisable to dévitalize two or more of the teeth most interfering with occlusion and then continue the grinding until the necessary change is effected. The devitalized teeth, of course, will have to be subsequently treated and filled.

In other cases, where the interference of one or two teeth is chiefly responsible for the condition, extraction may be resorted to. In some instances the author has found it necessary both to extract some teeth and shorten others by grinding in order to obtain even a moderate degree of improvement.

Lack of Posterior Occlusion.—Cases of this character are very rarely met with, and when not complicated with other adverse conditions, such as extensive decay, may usually be corrected by mechanically changing the relations of the superior and inferior incisors so as to bring them into normal occlusion. After this has been done the posterior teeth will, in time, of their own accord, usually become sufficiently extruded or elongated to come into contact. Should this extrusion fail to occur unaided, means will have to be adopted to bring it about. If any of the unoccluding teeth are extensively decayed, the matter of correction will be simplified, for we can then crown them, and in so doing add to their length sufficiently to bring them into contact with their opponents. A case involving the several features just alluded to and the means adopted for their remedy is described by Dr. Willis.* The patient was a young lady sixteen years of age, and when she presented the right superior central incisor was the only one of the superior incisors that occluded with the lower.

FIG. 174.



Lack of Posterior Occlusion. (Willis.)

Fig. 174 represents the case before treatment.

"There was a space of a quarter of an inch between the upper and lower bicuspids and molars when her jaws were closed.

"A Coffin split-plate, with piano-wire spring, was made to spread the upper bicuspids and molars. This was worn for six weeks, at the end of which time the bicuspids and

Dental Cosmos, Vol. XXXVII., pp. 584-5.

molars were directly over the corresponding teeth of the lower jaw, the arch having been widened about a quarter of an inch.

"As the cuspids originally occupied about their right positions, the next step was to move forward the central and lateral incisors."

After describing how this was done, the article continues :—

"The lower molars and bicuspids were badly broken down from decay, some of them having been filled half a dozen times. To put them in good condition and raise their grinding-surfaces to articulate with the upper teeth, they were crowned.

"In order to avoid too great a display of gold on the first bicuspids, a new method was resorted to in crowning them. A gold band was fitted around the tooth, extending about a sixteenth of an inch above the end of the tooth. An impression and bite were taken at the same time by covering the tooth and band with plaster, and closing the jaws while the plaster was soft. The band and plaster were removed intact, and Mellotte's fusible metal poured into the band. The crown was placed on the articulator, and a bite completed with Mellotte's metal and plaster. The plaster was now removed from the band, leaving a metallic surface one-sixteenth of an inch below the top of the band into which to fit a porcelain top for the crown.

FIG. 175.

A. Porcelain Tip.
B. Gold Band.

"In this case an ordinary plain tooth, such as is used in vulcanite work, was selected and ground to fit into the gold band and of the right length to articulate with the upper teeth. This porcelain tip was cemented into the gold band, and the whole removed from the articulator. The fusible metal was heated a little, and readily came away from the crown.

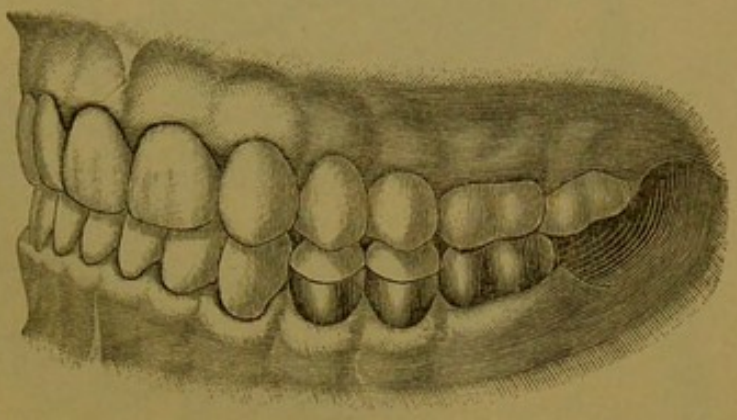
Fig. 175 represents the completed crown before the two portions were joined together.

"These crowns were cemented over the natural teeth and

produced a nice appearance as nothing but the porcelain showed when the mouth was opened, the lip and tongue entirely hiding the gold band.

"A crown of this description is particularly adapted for the lower molars and bicuspids, especially when they need to be brought up some distance above the natural tooth.

Fig. 176.



Corrected Case.

Fig. 176 represents the case after correction.

"A very small vulcanite retaining plate was worn to hold the upper teeth in position."

Lack of Lateral Occlusion.—This form of irregularity is usually confined to one side of the arch and is generally caused by late eruption of the bicuspids after their allotted space has been encroached upon by the adjoining teeth to such an extent as to prevent their full eruption.

If the extraction of some tooth to make room is not deemed advisable, forcible extrusion must be resorted to.

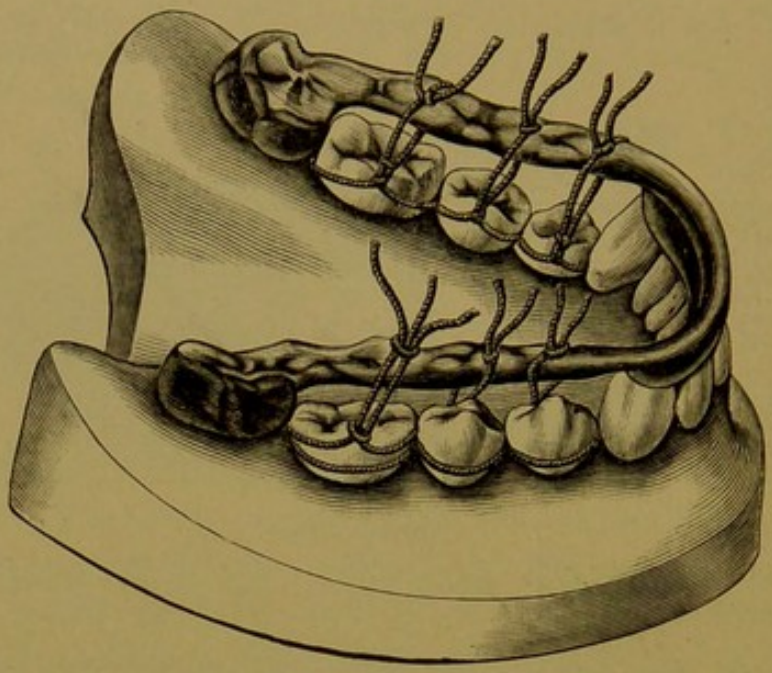
One way of accomplishing this in a case involving both sides of the arch is described and illustrated by Dr. Davenport.* The patient was a young lady whose superior anterior teeth protruded abnormally.

In reducing the deformity by retracting the superior incisors the occlusion of the anterior teeth prevented the side teeth from coming into contact. To elevate the latter he constructed a bridge appliance of gold consisting of caps for the molars, a saddle for the six anterior teeth and a frame work connecting the two. The whole device was so shaped as to furnish a suitable masticating surface for the upper

Dental Review, Feb., '96.

teeth. The short bicuspids and molars were then ligated to this bridge and thus drawn gradually to a proper height.

Fig. 177.



Appliance for Extrusion. (Davenport.)

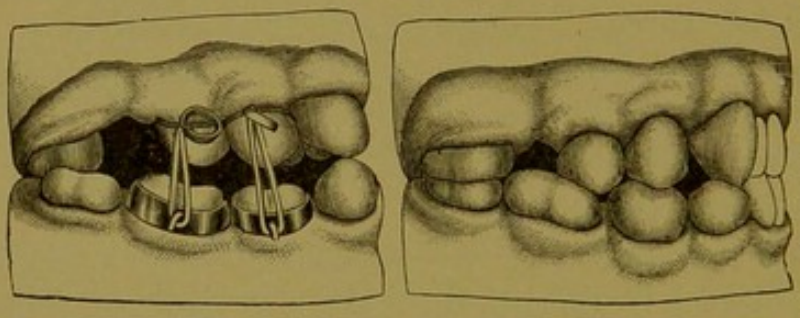
The appliance in position is shown in Fig. 177.

Another case of lack of lateral occlusion, involving only the bicuspids on one side of the mouth, is reported by Prof. Goddard.*

Fig. 178 represents the case before and after correction, together with the appliances used.

The writer says :—" Bands with hooks are attached to both upper and lower teeth and a rubber ring stretched from each upper hook to the corresponding lower one, or the place of either upper or lower band may be supplied by a ligature.

Fig. 178.



Lack of Lateral Occlusion. (Goddard.)

" The patient should unhook each ring while eating, and readjust it afterward."

* The American Text Book of Operative Dentistry, p. 597.

CHAPTER X.

INTRUSION AND EXTRUSION.

The term Intrusion, in orthodontia, denotes the act of thrusting or pushing a tooth deeper into its alveolus, while Extrusion signifies the pushing or drawing of a tooth partly out of its socket. The two movements are therefore exactly opposite in character.

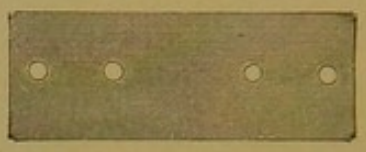
Intrusion.—Normally, each tooth will advance in the course of its eruption until the whole of its crown projects beyond the free margin of the gum, and its cutting edge or masticating surface is in proper relation with the same surfaces of the adjoining teeth. Full eruption may be delayed or entirely prevented, but extra elongation will not occur except through accidental circumstances. When it does occur, it is usually the result of an abnormal condition of the pericementum, due to irritation in some form, or it is caused by lack of occlusion with teeth in the opposite jaw. In the latter case, it is but the manifestation of nature's attempt to rid the system of a useless organ.

Extrusion of one or more of the teeth sometimes occurs in connection with regulating and is due either to the irritation of the soft tissues surrounding the tooth caused by the impingement of the regulating appliance upon them, or to the unfortunate application of power in such manner as to favor the lifting of the tooth from its socket.

When such extrusion is noticed it becomes necessary to remove the cause and give rest to the affected parts. The elongation being due in the first instance to the temporary thickening of the peridental membrane through irritation, a period of rest will usually result in the subsidence of the trouble and the return of the tooth to its former position.

Where the extrusion is the result of misdirection of power the operation will have to be suspended for a time, to be followed by the use of more suitable appliances. Should the condition, however, be allowed to continue for any length of time, as through non-appearance of the patient, some pressure may have to be applied to force the tooth back into its socket. This may be accomplished in a variety of ways. A simple plan has been suggested by Dr. Wilhelm Herbst.

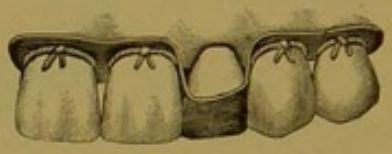
Fig. 179.



Herbst Method of Intrusion.

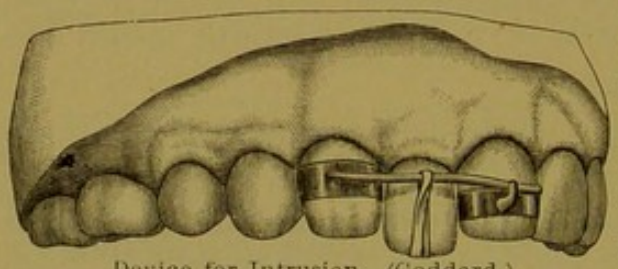
It consists in cutting a short and narrow strip from a piece of rubber dam and perforating it in such manner that when in position, the crowns of two teeth on either side of the one affected will protrude through the openings, while the extruded tooth will be partly covered and pressed upon by the intervening portion of the rubber. Figs. 179 and 180 represent the strip of rubber separately and in position.

Fig. 180.



Rubber Strip Applied.

Fig. 181.



Device for Intrusion. (Goddard.)

Another way of producing tension upon the elongated tooth is by means of a rubber plate with a strip of gold so attached as to rest and press upon the cutting edge of the tooth.

A far better method is the one adopted by Prof. Goddard,* and shown in Figs. 181 and 182.

It consists in banding a tooth on each side of the one to be operated upon and connecting the bands by wires soldered to both their labial and lingual surfaces; or, as shown in cut 182, soldering the wires to but one of the bands, and

* The American Text-Book of Operative Dentistry, p. 594.

allowing their free ends to rest upon hooks attached to the other band. When in place, a slender rubber ring is stretched from one wire to the other, passing in its course over the incisal edge of the extruded tooth. A small cap with a notch in it should be cemented to the long tooth to keep the rubber in position.

FIG. 182.

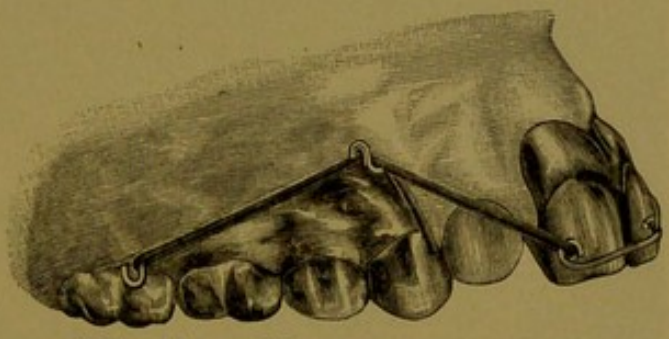
Detail of Construction.

Fig. 182 shows the method of construction.

Dr. Ottolengui describes and illustrates his method of retracting and intruding two central incisors at the same time.*

He says:—"In this instance the patient was but nine years of age, and it was necessary, as a primary step in the correction, to retract the two central incisors. A cap of pure gold was constructed by swaging, and this, having a wire soldered across the labial surfaces, forming two loops, was then cemented to the two teeth. Continuous caps for the molars (both temporary molars on each side being still in place) were then made in the usual manner, except that the metal was extended to cover the gum at the buccal aspect, extending high up under the lip opposite the site of the first bicuspids (had they been present). The upper edge of this plate was made rigid and comfortable by soldering a wire along the edge. At the highest point in the bicuspid region a hook was fashioned and another opposite the molar. These caps were also held in place with cement. At the outset the rubber ligatures were attached, stretching from the corners of the incisors to the first and highest hooks on

FIG. 183.

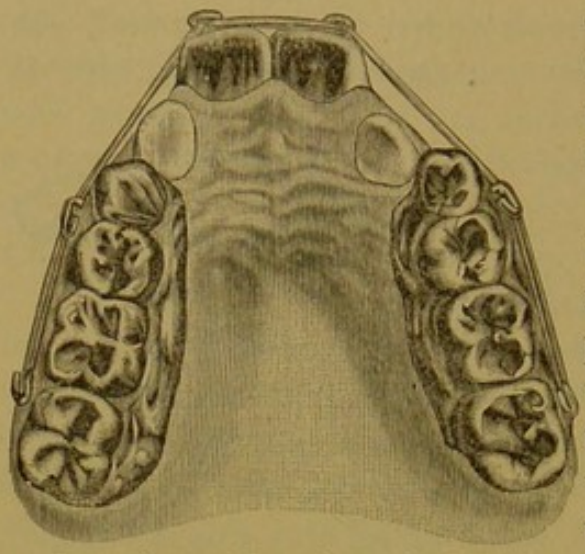


Retraction and Intrusion. (Ottolengui.)

* Items of Interest, July '97, p. 511.

the back pieces. Later, as more pressure became endurable, the ligatures passed over these hooks, and back to the hooks opposite the molars. In either arrangement the ligatures exert pressure upward as well as backward.

Fig. 184.

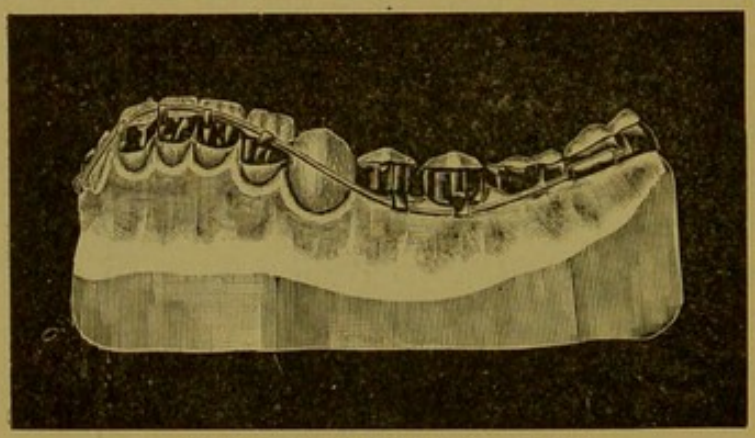


Retraction and Intrusion. (Ottolengui.)

Figure 183 shown the buccal aspect of the apparatus, with the ligature in position. Figure 184 shows the roof of the mouth, and the general shape of the various pieces cemented to the teeth."

An ingenious device, designed by Prof. Case * for the double purpose of intruding the incisors and extruding the bicuspids, is shown in Fig. 185.

Fig. 185.



Intrusion and Extrusion. (Case.)

In describing its construction he says:—"On each molar (first or second according to the age of the patient) is placed a hollow metal crown on the buccal surface of which is soldered an open tube or trough, opening upward. On each bicuspid is cemented a band with a buccal hook pointing downward, also on the first molar if the second has been used for supporting the hollow crown.

* Dental Review, Dec. '95.

On the incisors are cemented bands with hooks turned upward. A labial bow of elastic German silver or piano-wire has its ends inserted in the troughs of the hollow crowns, its front resting above the hooks on the incisors, and its sides pressed under the hooks on the bicuspids and first molar. The action is such as to depress the incisors and elevate the bicuspids, and, if possible, the first molars also."

Extrusion.—Incisor teeth which have not erupted to their full extent and have been prevented from doing so by the too close proximity of adjoining teeth or other cause, may often be assisted in assuming their proper alignment. Where space exists, teeth will naturally accomplish their full eruption unaided, as previously stated. When they do not, and there is no visible cause for their not doing so, we may safely infer that some hindrance exists in the tissues beneath the gum. It may only be an unexplainable suspension of the act of eruption, or it may be, and often is, a curvature or enlargement of the root that prevents the further progress of the tooth. Which of the two it is, can usually only be decided after measures of assistance have been tried.

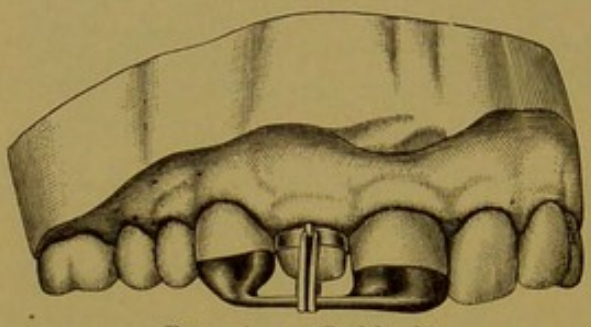
If the delayed eruption has been due simply to a suspension of the act of eruption, the simplest and most effective remedy will be found in tying a silk ligature around the neck of the tooth and pressing it well under the free margin of the gum, or in placing a ring cut from rubber tubing in the same position. Either one will cause irritation of the pericementum, which by consequent enlargement will tend to force the tooth out of its socket. To prevent undue elongation the case will have to be carefully watched, day by day, and the irritating ligature removed as soon as the tooth has been sufficiently elongated. If this be neglected, the tooth may be entirely expelled and lost.

Should these simple means fail to move the tooth from its abnormal position, osseous abnormality is probably the hindering cause, and mechanical appliances of not too great

power should be tried. Some of this character have already been mentioned.

Where full eruption of a tooth has been made impossible by the impingement of adjoining teeth upon the space intended for it, increase of space by lateral pressure upon the interfering teeth should first be gained before any attempt is made at elongation. Indeed, the mere enlargement of the space and its retention for a length of time will usually be followed by the unaided eruption of the tooth. Should this not occur mechanical assistance will have to be rendered by some method.

FIG. 186.

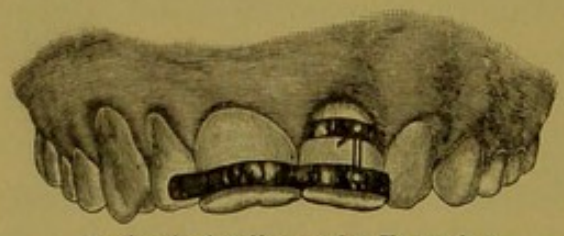


Extrusion. (Goddard.)

Prof. Goddard produces extrusion of an incisor by means of the appliance shown in Fig. 186.

It consists of partial caps of gold fitted to the two adjoining teeth and connected by a wire soldered to them. The partially erupted tooth has a Magill band cemented to it, and on the central portion of this band on both labial and lingual sides is soldered a hook or pin. After the connected caps are cemented in place a rubber ring is caught over one hook, passed over the yoke, and caught on the other hook.

FIG. 187.



Author's Appliance for Extrusion.

Fig. 187 shows the author's method of producing extrusion. The patient, a boy, had broken off the mesio-incisal corner of his superior left central. Instead of trying to restore the broken portion by filling, it was decided to draw the tooth down and grind off the incisal edge.

To do this, a Magill band was snugly fitted to the right central, and a corresponding band (but larger than the tooth) was soldered to it at its periphery to surround the left central. A smaller Magill band was fitted to the broken tooth and cemented in position close up to the gum. Each of the bands surrounding the left central had a headed tooth-pin soldered to its central portion. After cementing the single band in place, the double band was cemented to the right central leaving the other portion of it free to pass over the left central with a space between the band and the tooth.

The pins on the two bands were now connected by means of platinum binding wire with the ends twisted together. Tightening the twist at intervals of a few days soon brought the tooth down below its fellows, when the projecting broken edge was dressed to a proper line with a corundum wheel.

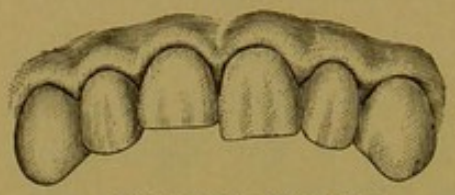
After the operation was completed, the appliance was kept in place for a month as a retainer. The virtue of this appliance consisted in its not interfering with mastication and in its simplicity and inconspicuousness.

Forcible eruption of a tooth by means of the extracting forceps is seldom justifiable, for we cannot always know what may have interfered with the eruption. In certain exceptional cases, where a careful examination reveals no sign of malformation of the root and where it is perfectly evident that slight impingement of adjoining teeth has been the sole hindrance to full eruption, the forceps may prove a valuable means of effecting a rapid and easy correction of the difficulty.

Such a case occurred in the author's practice. The patient was a gentleman of about twenty-eight years of age, whose right central incisor was about a line shorter than its mate. It had been tardy in erupting and in consequence there was a slight lack of space for its accommodation, as shown in Fig. 188.

As the difference in length of the two incisors was too great to be remedied by the simple means of reducing the length of the longer one, it was decided to elongate the shorter one. A careful examination proving favorable, a piece of sand paper was folded so as to cover both labial and lingual surfaces of the tooth to protect it from injury, after which it was grasped with the forceps and by a combined rotary and downward motion brought into place. Once in position, it was held there firmly by the pressure of the adjoining teeth, but as good judgment would not sanction so unreliable a means of retention, an appliance had to be devised that would not only prevent the tooth from slipping back into its socket but also secure it from being forced forward by pressure upon its sides. The patient also desired the appliance to be as inconspicuous as possible.

FIG. 188.



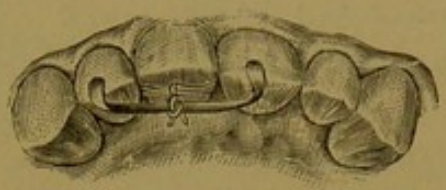
Incomplete Eruption.

To accomplish all of these ends, a piece of platinous gold wire, a little thicker than a vulcanite tooth-pin, was bent into horseshoe form and curved to conform to the lingual surfaces of the retarded tooth and the two adjoining ones. The ends of the wire were then flattened and bent so that they would hook over and rest upon the incisal edges of the adjoining central and lateral. A silk ligature was passed around the moved tooth and tied in front, after which the ends were again passed to the lingual surface and tied just below the cingulum. After the gold wire was placed in position, the ligature was attached to it at the lower point of its central curve.

The ligature thus held the appliance in position and it in turn kept the tooth from receding. The double arrangement of wire and ligature also guarded the tooth against

the possibility of moving forward. The fixture in position is shown in Fig. 189. The only parts of it visible were the small rounded gold tips that overlapped the incisal edges of the two adjacent teeth.

FIG. 189.



Retention after Correction.

Where sufficient space exists for the purpose, the tooth after being drawn into position may be held by means of the platinum band and extension bar, as shown elsewhere for retaining a tooth that has been forced backward into the line of the arch.

CHAPTER XI.

SURGICAL CORRECTION.

The correction of irregularity of the teeth by surgical methods has been, as yet, but little attempted owing to its limited applicability and its seeming violence. The more conservative method of slow movement has continued to prevail because it accomplished its object and was not likely to be accompanied by any ill-results.

In these days, however, when minor surgery is being more resorted to by the dental practitioner in the treatment of antral disease, root amputation and the implantation of teeth, there would appear to be no good reason why the practitioner in the line of orthodontia should not avail himself of the benefits to be derived from surgical procedure.

The teeth being strong and hard bodies are not liable to fracture; the investing perecimentum is a membrane of great vitality and strong recuperative powers; the cancellate tissue of the alveolar process is open and readily broken down and the cortical layer in certain localities is thin and elastic. The only source of danger in rapid and forcible movement of the teeth lies in the liability of devitalizing the pulp which is a delicate organ and readily injured. This liability can, however, be reduced to a minimum by proper precaution and a judicious selection of cases to be operated upon.

It seems safe to predict that when the possibilities of luxation are more fully appreciated and the methods for its proper performance have been more perfectly developed it will, in a limited class of operations, largely supplant the slower methods which have so long prevailed. The first recorded efforts at forcible movement of teeth are those of

Sir John Tomes.* He confined the operation to rotation of teeth in their alveoli in young subjects before the osseous tissues had become fully calcified. He reported success in nearly every case operated upon. Since then the same operation has been successfully performed by numbers of practitioners with very general success.

The practice has to be confined, of course, to single-rooted teeth with nearly round and straight roots. The difficulty of determining whether a concealed root is straight or curved, renders the operation a somewhat hazardous one, for with a curved root there is danger of fracture. In performing the operation, a forceps should be selected whose beaks nearly fit the tooth at its neck and to prevent slipping and guard against injury to the enamel, a piece of heavy sand-paper (with the sanded surface next to the tooth) should be laid entirely over the crown before it is grasped by the forceps. When it is seized, rotary motion should be made back and forth until the tooth is loosened, after which it should be steadily turned in the desired direction until it reaches its proper position. It may be retained either by silk or wire ligatures, or preferably by a metal cap or splint (previously formed) cemented to it and an adjoining tooth on each side. The tooth will usually become firm in the course of ten days or two weeks.

The next contribution to the subject was a paper read before the American Dental Society of Europe, at Basel, by Dr. L. C. Bryan, in August, 1892.† In his paper, Dr. Bryan relates his method of surgical correction as follows:

"The treatment which I have finally adopted is to inject cocaine and either partially cut away the thick intervening alveolus with drills and long fissure-burs, or, when the alveolus is thin, bodily wedge the outer alveolar wall away with a half round, wedge-shaped chisel, by inserting the point of the instrument between the tooth crown and the

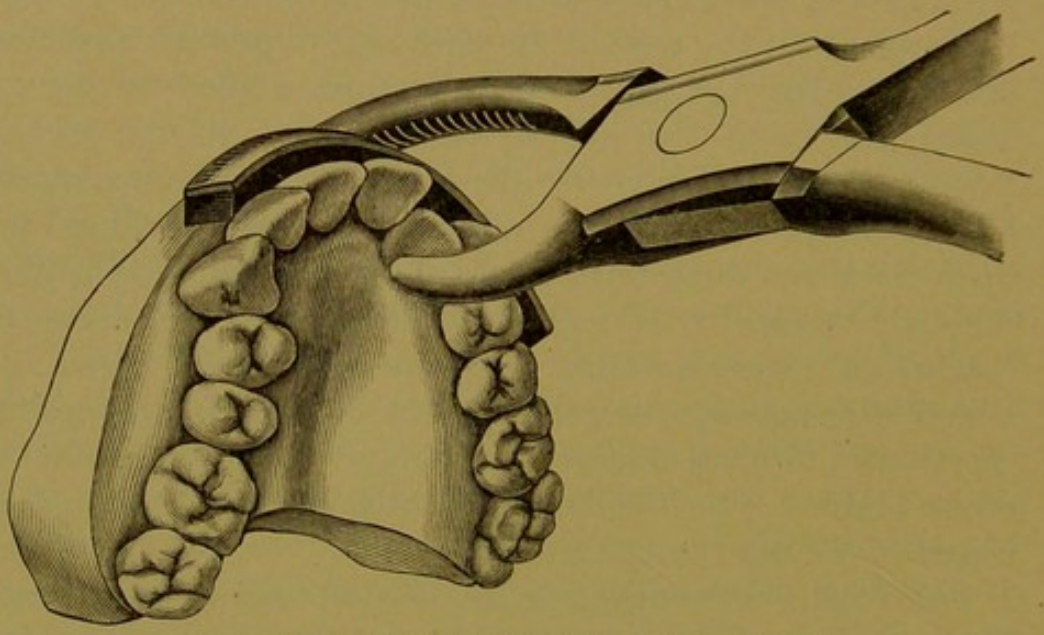
**Dental Surgery*, 2nd ed., p. 162.

†*Dental Review*, Vol. VI., p. 858, *et seq.*

bone, and forcing it up along the root until enough space is secured for the tooth to be brought out into place outside of the lower tooth.

"This latter I formerly accomplished by pressing the above wedge-shaped instrument or the inner beak of a suitably formed forceps up along the palatal surface of the tooth until the crown was forced outward sufficiently to be firmly grasped. It was then brought gradually out into place, and secured with a small plate, or ligatures. My present method of

FIG. 190.



Forceps and Fulcrum for Tooth Luxation. (Bryan.)

operating is much simplified by the forceps and fulcrum which are herewith presented.

"As you will see it has lobster-claw jaws or perhaps it more resembles the Tapir's jaws with round drooping proboscis and the short receding lower jaw. This long, serrated jaw rests upon a fulcrum fitted to the arch of the maxilla to be operated upon, and the short beak pushes against the palatal aspect of the tooth to be brought out into line.

"I consider it absolutely necessary to lift the outer alve-

olar plate before attempting regulation on account of the great danger of accident to the pulp if the alveolar margin including the solid septa between the teeth are not broken up.

"By the injection of cocaine, or the application to the gum of calorific fluid, the pain of drilling, or breaking away the bone, can better be borne by highly sensitive or nervous patients than the continued pain of regulating pressure, and consequent systemic disturbance from inflammation and broken rest. When general anæsthesia can be resorted to, the work can be done more thoroughly and carefully."

In 1893, Dr. Geo. Cunningham of England, read a paper at the World's Columbian Dental Congress,* entitled "Luxation, or the Immediate Method, in the Treatment of Irregular Teeth," in which he reported a number of cases operated upon by him surgically for irregularity. The operations were much more extensive in character than those performed by Dr. Bryan or anyone previously, and while all were not successful the majority of them were. His practice in this line had extended over some seven years, and his experience warranted him in continuing it. His method of procedure did not differ in any essential particulars from that of Dr. Bryan, except that in extensive operations he administered a general instead of a local anæsthetic.

Dr. Talbot's method † differs from those of his predecessors in that he combines both surgical and mechanical means in accomplishing his object, and throws around them the safeguard of aseptic treatment. He claims for his method that it is very advantageous where dense tissue needs to be removed, and in cases where it is difficult to obtain sufficient anchorage inside of the mouth. By thus removing the chief obstruction to tooth-movement, teeth may be moved by depending upon an anchorage which, in ordinary cases, would be entirely inadequate. He describes his method as follows:

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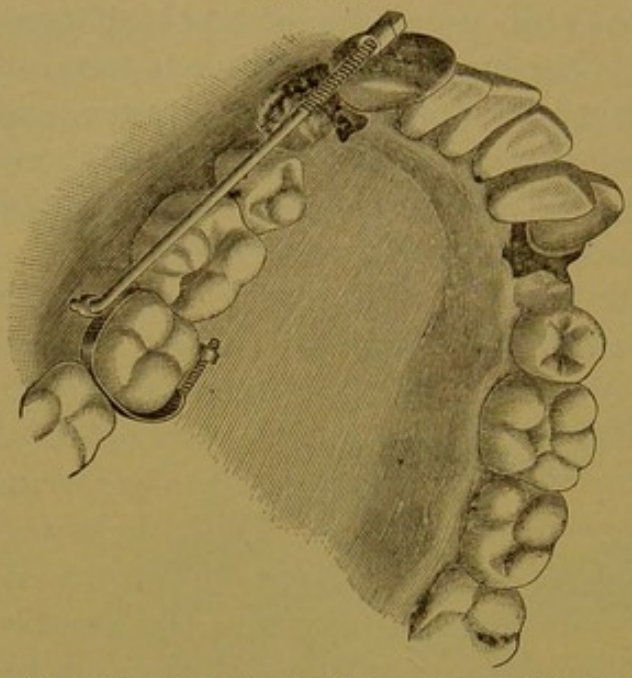
* Transactions, Vol. I., p.

† *Dental Cosmos*, Vol. XXXVIII., p. 909.

"My method consists in removing the alveolar process in the line of travel of the tooth to be moved, leaving a small amount about the root of the tooth to hold intact the peridental membrane. This is accomplished with coarse-cut Revelation burs, or those that will cut in all directions.

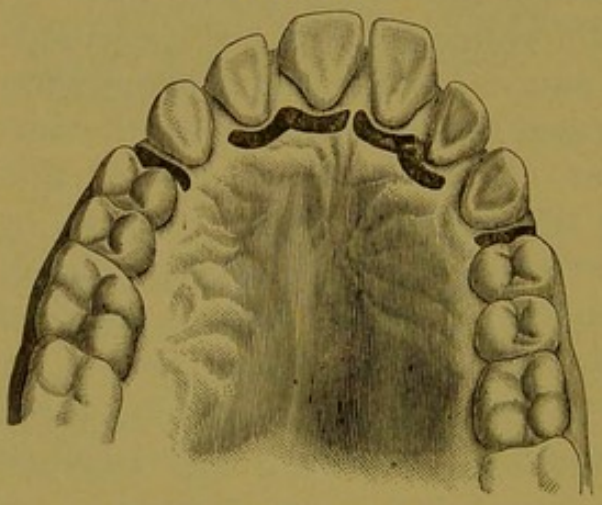
FIG. 191.



Surgical and Mechanical Correction. (Talbot.)

"If a cuspid requires to be carried backward, make an appliance with bands about the first and second molars, with cap upon the cuspids and a bar with screw and nut upon the end, as recommended by Dr. Farrar. Extract the first bicuspid and then resting the hand against the cuspid, cut out the palatine and buccal V-shaped plate with a bur, making a concave surface of the alveolar process, as illustrated in Fig. 191.

FIG. 192.



Resection Previous to Inward Movement. (Talbot.)

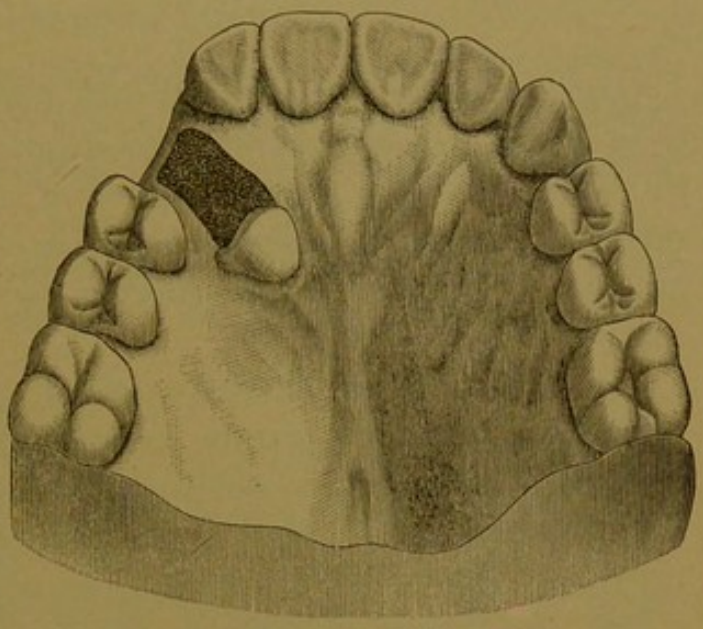
If the superior incisors are to be carried back, cut semi-circular spaces just posterior to the teeth to be moved as shown in Fig. 192.

"To move into line a cuspid which is erupting in the vault of the

mouth, remove the alveolar process in the direction of the line of travel as in Fig. 193.

In moving teeth laterally by a jack-screw, it will not infrequently be found that one tooth moves faster than the other. To bring both to their proper positions cut out the alveolar process on the side of the slower moving tooth, and both will come into proper position, see Fig. 194.

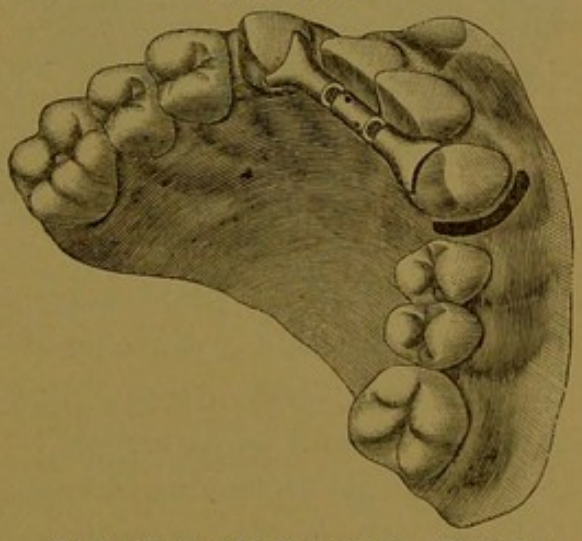
FIG. 193.



Path Prepared for Cuspid. (Talbot.)

"In this manner teeth not only may be moved very rapidly and without much pain, but we have the tooth or teeth to be moved completely under control. Any of the teeth in the mouth may be used for the fixed point of resistance, thus doing away with all unsightly appliances outside of the mouth.

FIG. 194.



To Assist Cuspid Movement. (Talbot.)

"When in place the teeth should be anchored in the usual manner. Antiseptic washes should also be used from time to time, such as one per cent. corrosive sublimate, listerine, or five per cent. carbolic acid.

CHAPTER XII.

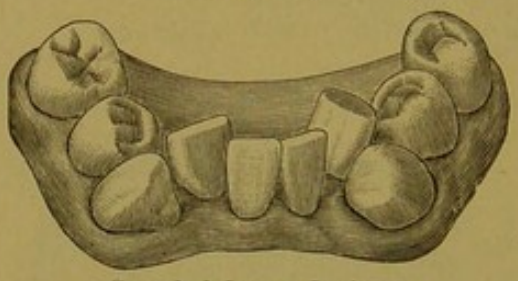
MISCELLANEOUS.

Crowded Lower Incisors.—While general consideration has been given to teeth erupting or situated inside or outside of the arch, there is one condition of rather common occurrence that calls for special mention. It is the crowded or jumbled condition of the inferior incisors after dentition is complete.

Fig. 195 shows an extreme case of this character.

The moving of a single lower incisor either inward or outward into line has been treated of in Part III., Chapters I. and II., but where several or all of these teeth are more or less out of line and possibly turned upon their axes, the condition becomes a somewhat difficult one to treat successfully.

FIG. 195.



Crowded Lower Incisors.

The expanding of the arch to permit of all of them being brought properly into line involves an operation of some magnitude, and is likely, in many cases, to disarrange an otherwise good occlusion. For these reasons expansion should not be attempted except in very rare cases, where improvement of the occlusion is desired and can be attained.

Two simple methods of treating these cases are open to us:—

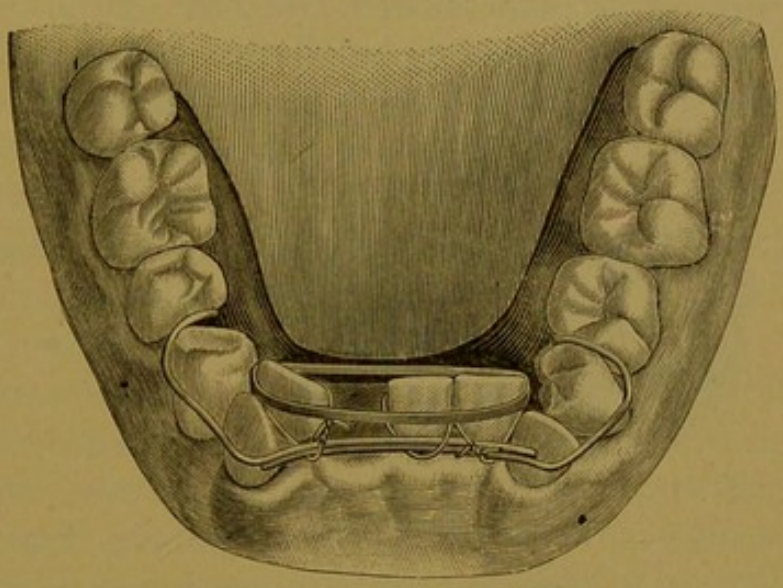
First, where the crowding is not excessive, each of the malposed teeth may be dressed off at the most prominent points of their approximal surfaces by means of hard rubber and corundum disks or by the more flexible emery-cloth disks, and by thus lessening their respective diameters proper accommodation may be found for them in the arch.

Second, where the teeth are very much crowded out of position and where the space between the cuspids is entirely inadequate for their accommodation it will be best to extract one of them in order to enable the remaining three to be brought into place.

As mentioned on page 45, the best tooth to extract in such cases is the one most out of line, or the one in such position as to enable the remaining ones to be most easily moved into proper alignment.

After extraction, means will have to be adopted to draw the teeth into position, in doing which the space created by extraction will also be closed. Perhaps the simplest way of drawing the teeth together is by the use of a rubber ring slipped over the teeth and kept from impinging upon the gum by a silk ligature wound several times around the terminal teeth near their necks and then tied to the ring itself.

FIG. 196.



Straightening Lower Incisors. (Kingsley.)

After the teeth are drawn together and the space closed, they may be aligned by any of the appliances illustrated for moving individual incisors.

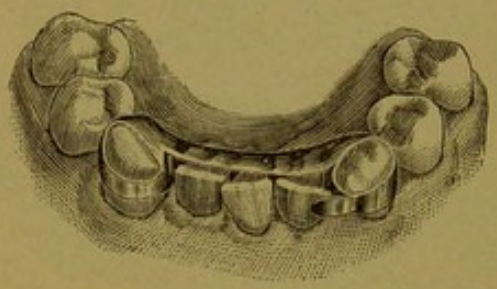
Dr. Kingsley illustrates and describes an appliance and method for drawing the lower incisors together (after one has been extracted) and moving them into line at the same time; Fig. 196. He says:—* "It was a vulcanite plate with piano-wires, one from each side, meeting and lapping in

Dental Cosmos, Vol. XXXIV., p. 106.

front, and in their relaxed positions standing off for an eighth of an inch from the face of the teeth, but were sprung in and tied to the incisors with waxed ligatures. This vulcanite plate was made pretty stout, comparatively non-elastic, and impinged upon the lingual walls of the bicuspids and molars, for the purpose of assisting nature, which was widening the arch by occlusion with the upper one, and, as from time to time it loosened by those teeth yielding, the plate was warmed and readjusted. A small ring from rubber tubing was also stretched over the three teeth to assist in closing the gap. In four weeks the space was closed. The retaining fixture was exactly like the regulating plate without the piano-wire attachments."

Another retaining appliance for cases of this character occupying but little space and holding the teeth firm, is shown in Fig. 197. It is constructed by fitting metal bands to the anchor teeth and then taking an impression of these in position, together with the lingual surfaces of the intervening teeth. A model of plaster and marble-dust, made from this impression, will enable us to fit the connecting strip, and after securing it in place with binding wire, solder it to the bands.

FIG. 197.



Author's Retainer.

Where greater accuracy is desired, the strip may be swaged up to shape by dies made from the same or a duplicate model.

The retainer can be made to do a little delicate adjusting by slightly trimming on the model the still prominent corners of any teeth which we may desire to move outward.

Tooth-Shaping.—During the act of regulating or after its accomplishment, one of the most useful accessory operations, when called for, is that of dressing or shaping certain teeth so as still further to improve their appearance.

This operation will probably not be necessary in the majority of cases we treat, but when indicated it adds very much to the patient's appearance and the satisfaction of the parent and operator. It may be accomplished by means of the file, corundum wheel, sand-paper disk or emery-cloth strips, each having value according to the requirements of the case.

It will not often be called for on the approximal surfaces of teeth, but when it is, much of the substance should not be removed and the surface should afterward be polished in the most perfect manner.

The author has had one case, and one only, in which such trimming of approximal surfaces seemed advisable. The patient was a young lady of about twenty-one years of age, whose anterior superior teeth were slightly prominent. The teeth were without interdental spaces and all of the posterior ones were so perfect in structure, alignment and occlusion, that the extraction of even one of them would have been regarded as an unwarranted sacrifice.

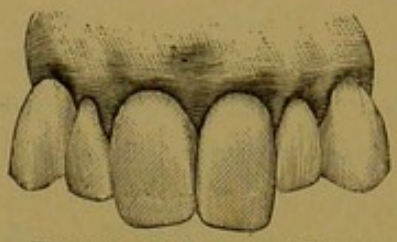
All of the six anterior teeth had small cavities upon each of their approximal surfaces, and it was therefore decided that in the filling of these cavities a slight portion of each approximal surface should be dressed off in the hope that the aggregate of such spacing would be sufficient to enable the teeth to occupy a position more in harmony with the normal line of the arch. After the filling and dressing of the surfaces the teeth were drawn inward and the result was all that could have been desired.

Sometimes teeth that have fully erupted out of line, when brought into proper position extend below the line of the occlusal edges of their neighbors and the rest of the teeth in the arch. Any attempt to reduce their elongation by forcing them up into the socket would not only be extremely difficult, but in many cases futile. The better plan, if the disparity in length be not great, is to grind off their occlusal edges somewhat, and thus accomplish the desired end in a very simple manner.

Fig. 198 shows a case of this character, and Fig. 199 the improvement after grinding.

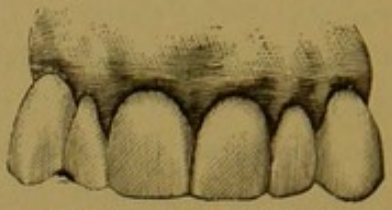
Again, teeth out of line have sometimes from lack of attrition preserved their normal, rounded form, while their fellows have more or less been worn away on their cutting edges either through abnormal occlusion or excessive use. When the malposed teeth have been brought into position their rounded and unworn edges are apt to contrast strongly with the abraded surfaces of their neighbors. By so dressing the incisal edges of the unworn teeth as to resemble those next to them, greater harmony of expression will result.

Fig. 198.



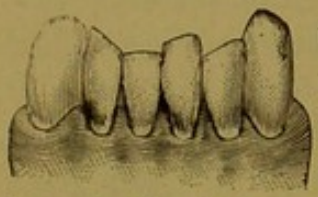
Elongated Centrals. (How.)

Fig. 199.



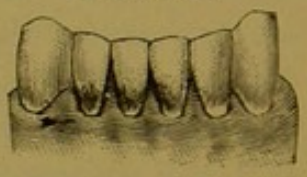
Improvement by Grinding.

Fig. 200.



Unevenly Worn Incisors. (How.)

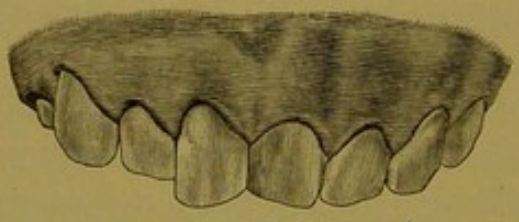
Fig. 201.



After Grinding.

Fig. 200 illustrates a case in which the worn condition and varying length of the lower anterior teeth presented a very unsightly appearance, and Fig. 201 represents the improvement made by reducing the length of certain ones and straightening the edges of others by grinding.

Fig. 202.



Anomalous Development.

Occasionally, teeth are so abnormal in some of their outlines as to resemble teeth of a different class, or, in the case of central incisors, they may appear to have changed their relative positions.

Fig. 202 represents a case of the latter kind, from the collection of Dr. Eggleston. In all such cases a judicious use of the corundum wheel will cause marked improvement.

Altering the form of a tooth, however, may often be made to serve even a more useful purpose than that of appearance. Cases have occurred where an upper tooth, tardy of eruption, has been unable to come entirely down into line owing to the meeting of its antagonist of the opposite jaw edge to edge. The retarded tooth might be forced sufficiently outward to enable it to accomplish its full eruption and then be held in position until overlapping had taken place, but the operation may be advantageously simplified in most cases by slightly beveling the edge or cusp of the lower tooth on its labial, and the upper one on its palatal surface. The inclined plane thus formed will enable the upper tooth to slide over the lower one into line, which it will almost certainly do provided there be no obstruction.

A case of this character came under the author's notice recently in which a superior lateral incisor was thus impeded in eruption until the individual was forty years of age. A simple beveling of the cutting edges of it and its opponent, induced it to come into proper line within a year.

Other conditions than those just mentioned will occur to the practitioner in which the slight alteration of the form of a tooth will materially assist, or be the means of entirely accomplishing some simple act of regulating, and in other cases, greatly add to the effect of some long-continued and otherwise successful operation in orthodontia.

Separation in the Median Line.—It is not very uncommon in the case of young persons to find the superior central incisors standing some distance apart instead of being in contact. The condition may be caused by an unusual thickening of the median septum, or by the late eruption of posterior teeth allowing the centrals to spread. If the space be not great, it will often become obliterated by the lateral pressure of the cuspids or other teeth forcing their way into position, but when there is no likelihood of this occurring the deformity should be corrected at once. If permitted to

exist it may interfere with distinct enunciation and prove a source of life-long annoyance.

Taken early, its correction is easy on account of the ready resorption of the process. So simple a means as a rubber band slipped over the two centrals will often close the space, but it will in turn produce spaces between the centrals and laterals.

A better plan is to employ Magill bands with a screw and nuts as shown in Fig. 80, page 128, except that the nuts in this case must operate on the farther sides of the tubes. After the centrals have been brought together by this means, the laterals can be drawn up close to them by rubber bands caught over the projecting ends of the screw and passing over the laterals. The rubber band over the left lateral should be caught over the screw-end farthest from it and the right lateral treated similarly. When corrected the teeth may be retained by thin metal bands cemented to the laterals, these being connected on their labial surfaces by a fine wire soldered to them. Should the centrals stand far apart and be perpendicular, drawing them together in the usual way will be likely to cause them to tip toward one another in an unsightly manner. This may be obviated by placing the bands and screw as near the cervical margin as possible, and then by continuing the application of force after the incisal edges are in contact, the power of the screw will compel the roots to move toward one another and recover their normal positions.

This closing of the space in the median line by the moving of the four incisors will, of course, create some space between the laterals and cuspids on each side, but it will be found by the time the retaining fixture needs to be removed, that the posterior teeth have moved forward and pressed the cuspids into contact with the laterals.

PART IV.

CHAPTER I.

CONSTRUCTION OF REGULATING APPLIANCES.

The principal tools required for the construction of metal regulating appliances are illustrated in Plates I. and II.

"*a*" is the ordinary mouth blow-pipe to be used in connection with a large alcohol annealing-lamp or gas Bunsen burner; "*b*" is the best form of jeweler's pin-vise, having pivoted jaws operated by an inclined plane on revolving handle. The handle is bored entirely through to receive wire of any length. "*c*" is a "snip" plate shears such as is used in crown- and bridge-work. "*d*" is a dental pin-punch and "*f*" a solder tweezers. "*e*" is known as a clasp-bender, and with its one beak of cylindrical form and the other concave is a powerful and useful instrument for curving and shaping piano or other stiff wire.

"*g*" and "*h*" are respectively flat and round nose pliers, while "*i*" is a heavy pliers for drawing wire or tubing, with notches in the joint for cutting wire. "*j*" is a small steel anvil mounted in a metal base, and "*m*" is a jeweler's saw-frame and saw. The figure at bottom of Plate I., is an adjustable die-holder and die with two taps for making screws and nuts. "*o*" is a pair of contouring pliers, while "*q*" and "*r*" are metal gauges. "*q*" is the Standard American (B. & S.) Gauge, very generally used for both plate and wire.* "*r*" is a micrometer gauge for more

*The numbers indicated in this chapter refer to the B. & S. gauge. A comparative table of the various gauge measurements, by which the equivalent of one may be found in any other, is appended to this chapter.

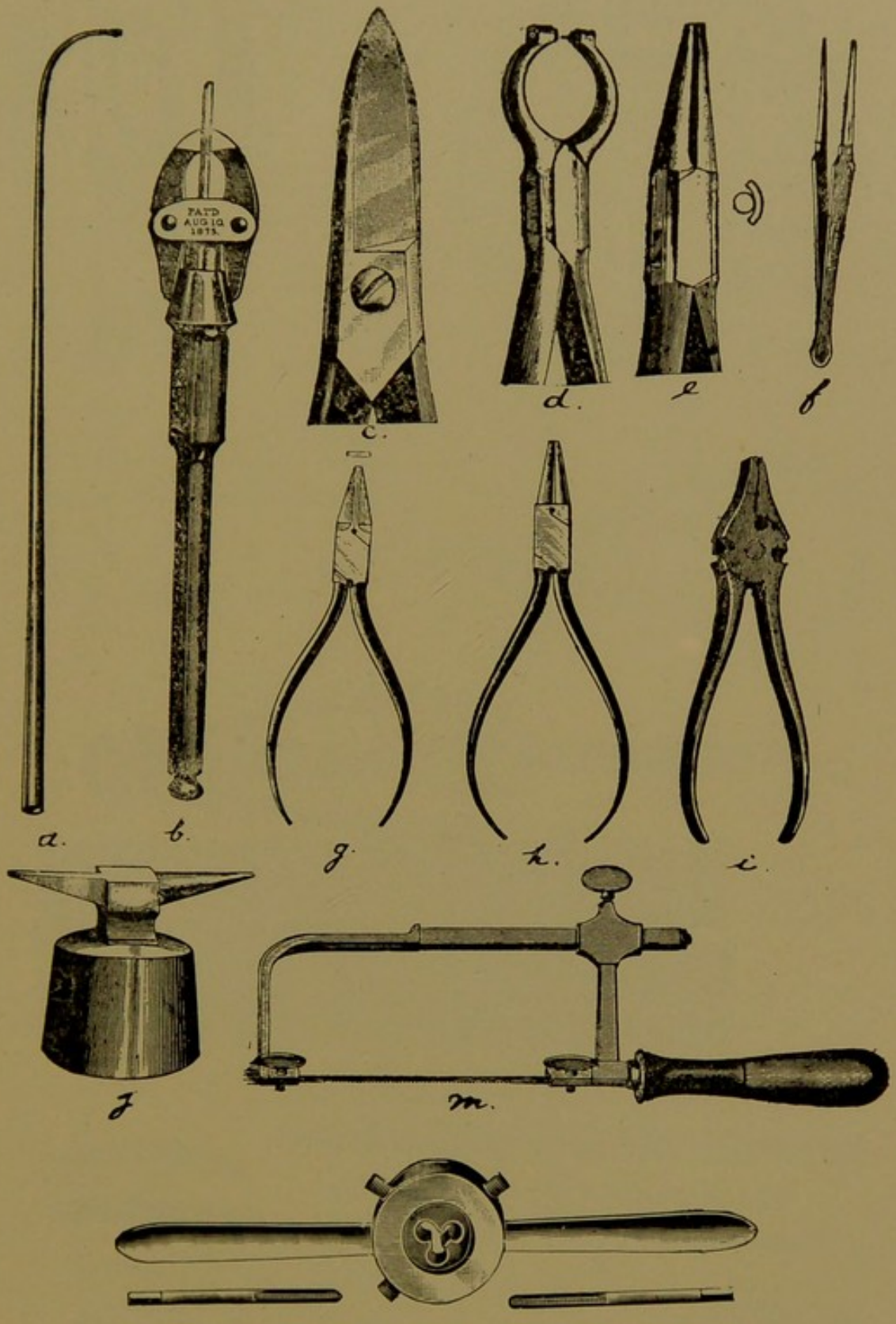
delicate and accurate measurements, which are indicated in thousandths of an inch. "*s*" is a double-calliper, with one end for inside and the other for outside measurement.

"*t*" is a self-closing tweezers for holding parts in soldering, and "*u*" a draw-plate, known as the "Joubert," with thirty different sizes of holes. The illustrations "*v*" to "*z*" will be referred to in the description of processes. "*aa*" represents a metal ferrule or band, the edges being drawn tight and held together with fine iron binding-wire. "*bb*," "*cc*" and "*dd*" are simple forms of wire clips for holding parts in position while soldering. They are made from piano-wire, Nos. 17 to 21, each about an inch in length. In "*bb*" both ends are beveled inward to enable them more easily to slip over the parts to be held. In "*cc*" one end of the clip is formed into a loop and the other bent at a right angle with flat termination. "*dd*" is a modification of "*bb*," one arm being curved near its end to hold a tube in parallel position upon a band.

"*gg*" is intended to represent the manner of holding a tube at right angles to the length of the band. The wire clip for this purpose has one arm bent at a right angle near its end and flattened and made concave to fit the tubing, while the other arm is straight, as in "*bb*."

"*hh*" represents an angled prong for holding parts in position upon a soldering block, as in constructing a gold T. It is made from a piece of piano-wire flattened and drilled at one end, tapering to a point at the other and bent at a right angle near the middle. The pointed end is easily forced into an asbestos or charcoal block at any desired place.

Ferrules or Bands.—Ferrules or bands for encircling teeth and serving as means of attachment for operating or retaining appliances may be made from gold plate (18 to 22 karats fine), platinous gold, iridio-platinum, platinum, platinous silver or German silver. All of those mentioned, except the last, will remain nearly free from oxidation, but German silver soon becomes discolored in the mouth. As a rule,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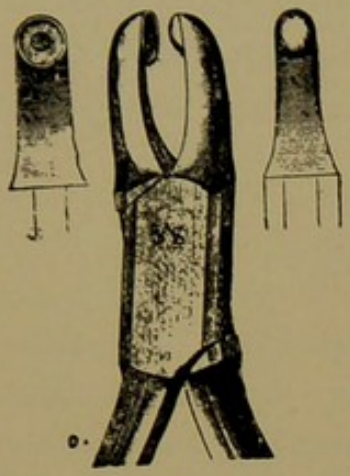
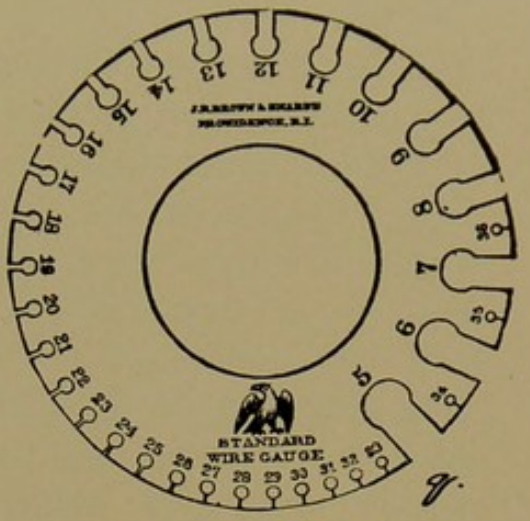
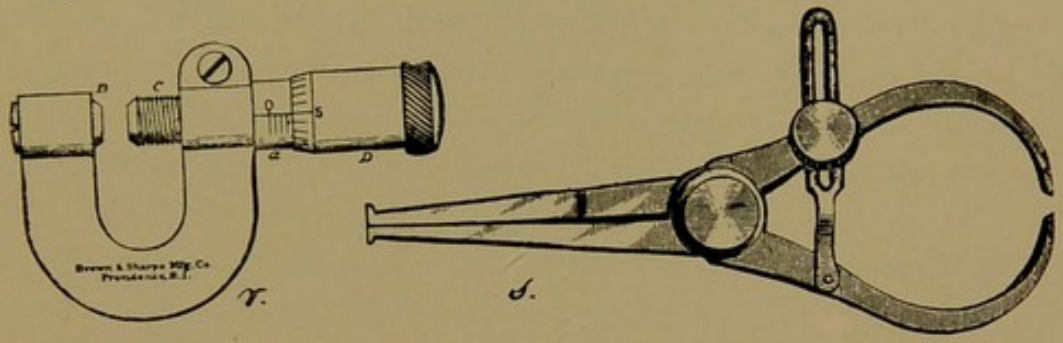
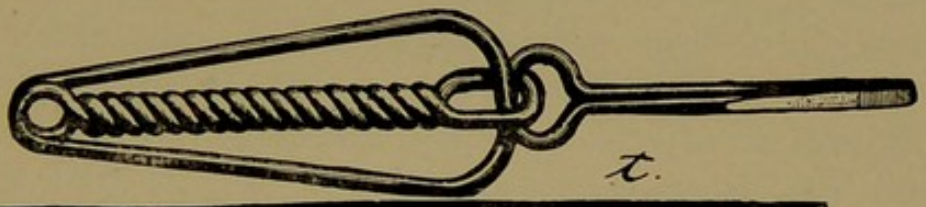
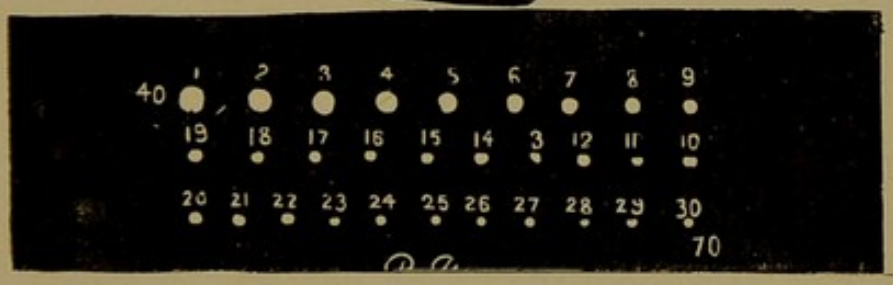
a.
b.
c.
d.
e
f
g.
h.
i.
j
m.




STANDARD
WIRE GAUGE



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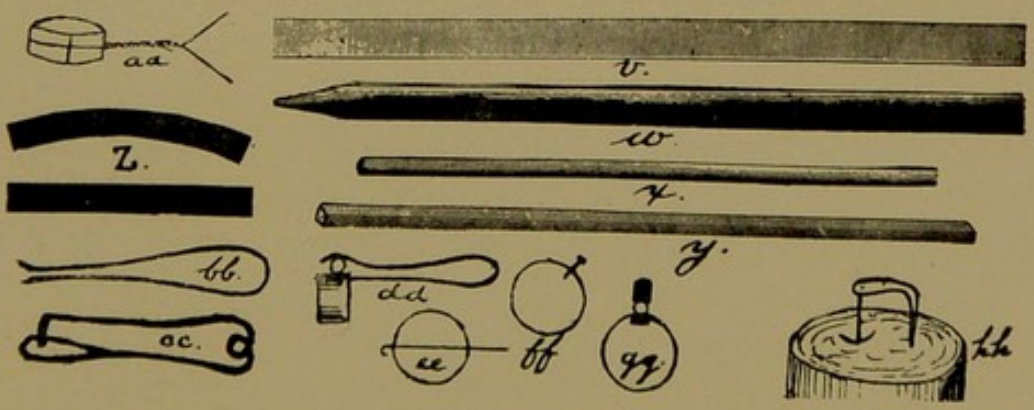


bands should be made to fit loosely so as to afford slight space for the cement which is to hold them in position, and where practicable, the tooth to be fitted should be freed from contact with its neighbors by previous wedging. As this cannot always be done, the bands in some cases will have to be forced over the teeth in spite of their contact. In such case they should be constructed from the stiffest and least yielding of the metals mentioned, such as platinous gold, platinous silver, or iridio-platinum. Bands made from these metals, even though thin, will retain their form without "buckling" while being forced into place. Where the teeth to be banded are not in close contact, any of the other metals will serve as well for the construction of bands. The band material should not exceed No. 32 in thickness and be cut into strips from $\frac{4}{32}$ to $\frac{5}{32}$ of an inch in width.

For the six anterior teeth the strips should be curved as shown in "*z*," so that when bent to encircle the tooth with the convex edge toward the gum, the ends will meet one another or overlap on the lingual surface in a nearly horizontal line.

For molars and bicuspids the band should be straight, and if desired, may be contoured transversely with the contouring pliers (*o*).

Ferrules are strongest when made with a lap joint, and their ends may be held in close apposition by passing binding wire around them (*aa*) and twisting the ends to serve as a holder while soldering in the flame of a lamp, or the lapped ends may be held with a wire clip (*bb*).

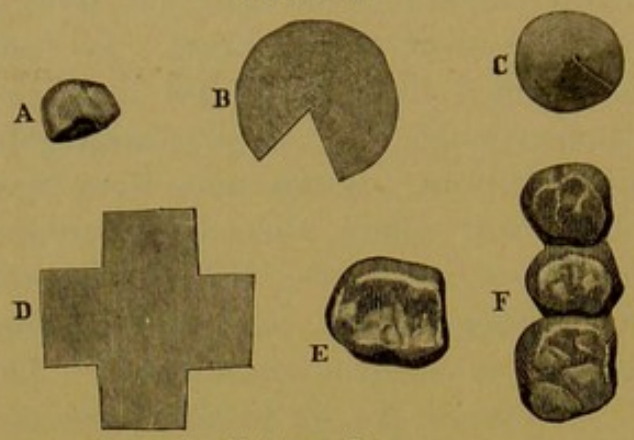
In some cases, as in partly erupted cuspids and deciduous molars, where the exposed portion of the crown is short and conical, it is better to have a cap entirely covering the crown so as to gain a firmer hold.

This is easily made by reproducing the crown in Melotte's metal, and after roughly adapting the cap to the natural tooth or its duplicate in plaster, completing the operation by swaging it between a die and counter.

Prof. Matteson's method of doing this is well shown in Fig. 203.

For a partly erupted cuspid he takes a circular piece of plate, and after cutting from it a segment, as in (*b*) bends it into the form of a cone (*c*) and solders the edges. It is then swaged to form between a die and counter. For a deciduous molar he cuts the plate into the form of a cross (*d*), folds the arms down, then swages and solders. In some cases, for more secure anchorage, he forms a chain of caps (*f*) by soldering several together.

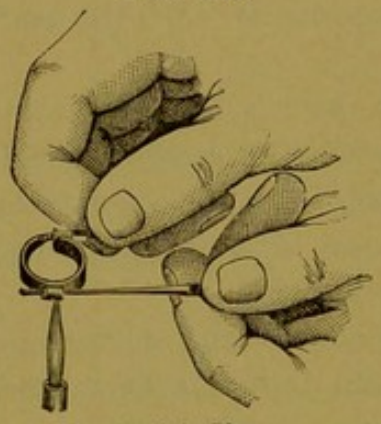
FIG. 203.



Matteson Caps.

The attachments that bands are most commonly supplied with are headed pins, wire hooks and pieces of metal tubing. Tubes are held in position upon bands for soldering by means of wire clips as shown in (*dd*) and (*gg*), or they may be held by means of a pointed instrument passed through the tube as in Fig. 204.

FIG. 204.



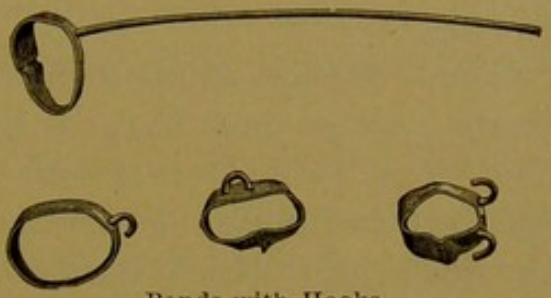
Angle's Plan.

As tubes are usually not soldered along their edges after being drawn, they can be closed at the time of soldering to the bands by placing the joint next to the band, and when desired to be left open the joint is turned away so as not to be included in the soldering.

Headed pins may be obtained from a vulcanite tooth, and after being filed to a point can be inserted into a hole drilled in the band, as shown in "*ff*."

When a band is to be supplied with hooks on opposite sides, a convenient way of attaching them is to drill a hole in each side of the band and pass entirely through them a wire bent into a hook at one end as shown in "*ee*." After soldering, the straight end is also bent and the wire cut from the centre of the band. A hook for one side only may be inserted and held like the pin in "*ff*" or a long wire, serving as a handle, may have its end tapered, inserted into the hole in the band and soldered over a lamp; after which it is cut to proper length, and the end bent into the form of a hook, as in Fig. 205.

FIG. 205.



Bands with Hooks.

Round Tubing.—Tubing for pipes or tubes can usually be obtained at jeweler's supply houses. It may be had of gold, brass or German silver or of one of the latter metals plated. It comes in lengths of about four inches, and is smoothly drawn but not soldered (*x*).

The thickness of the tubes is generally greater than we desire, but after soldering the joints with silver solder, the inside diameter can be enlarged with an engine bur, a spear or fissure drill, or jeweler's reamer. In many cases it may be desirable or necessary to manufacture our own tubing, which can be done as follows: Select a piece of metal plate of suitable gauge (No. 27) and cut from it a strip of desired length and of a width equal to three and a third times the outside diameter of the proposed tubing (*v*). Shape one end of the strip like the nib of a pen and curve or round the entire piece somewhat by forcing it into a groove cut in a block of hard wood, using a piece of wire and hammer for the purpose (*w*). The pointed end is then passed into one of the larger holes of the draw-plate, seized with the pliers (*i*) and drawn through. This operation is repeated through the holes next in size until the cut edges of the strip are in

close apposition. If it be desired to reduce the external diameter after the tube is formed, it can be done by simply continuing the process. As the drawing stiffens the metal it will be necessary to anneal it occasionally during the process. Where the tubing is to be used in considerable lengths without soldering, where great stiffness is required, as in the Angle encasement for jack-screws, there should be no annealing of the metal near the close of the operation of drawing.

Square Tubing.—This form of tubing cannot always be bought, and so may have to be manufactured. The strip should first be converted into a round tube, as previously described, and drawn to near the proper size in the ordinary draw-plate, after which the last four or five drawings must be made through a square hole draw-plate. When made of plate a little heavier than usual, and drawn to a size to fit the wrench or key, it is admirably adapted for the construction of small nuts as well as heads of screws. See Fig. 206.

FIG. 206.

Square Tubing.

Sections of any length can be cut from it with a jeweler's saw, after which by grasping them in a hand-vise (*b*) they may be readily drilled or reamed to proper size and tapped. The saw should always be set in the frame with the teeth pointing toward the handle so that the cutting is done in drawing the saw backward. Reversing the operation would cause the back of the frame to spring and the saw be liable to break in consequence.

Wire-Drawing.—The process of drawing wire down to size is very similar to that of drawing round tubing. Steel wire cannot be drawn by hand, but can be bought in all sizes. Gold, platinum, platinous silver or German silver wire, however, can readily be reduced in diameter and correspondingly lengthened by means of the draw-plate (*u*) and the heavy pliers (*i*). Before using the draw-plate, the holes

should be filled with melted bees-wax or equal parts of bees-wax and tallow to act as a lubricant. It is then clamped firmly in the bench-vise. The wire after being annealed should be reduced at one end by filing or hammering and the pointed end passed through the hole in the draw-plate next less in diameter than the wire itself. It is then grasped by the pliers (*i*) and drawn through with a continuous and steady pull. In similar manner it is drawn through the successively smaller holes until the desired gauge is obtained. After each three or four drawings the wire should be annealed.

Bending Wire.—Wire may be bent into any form by means of the various pliers, assisted at times by the bench- or hand-vise. Any curve can be given to it with the round-nose pliers (*h*), or the clasp bender (*e*), while for bending it at a right or acute angle, it should be held in the vise or pliers close to the bending point and the free end grasped and bent over with the flat-nose pliers. If the wire be of large size it may best be bent at a right angle by grasping it in the bench-vise and forcing the free end down with a hammer.

When piano wire needs a sharp bend it should always be done in this latter manner. For bending piano wire into a short curve, as for making or altering the form of the Coffin W-spring, the clasp-benders (*e*) should be used, on account of their convenience and superior power.

Soft-Soldering.—In uniting small parts of appliances by means of soft-solder, they may be held in the tweezers (*f*), (*t*), or the spring clips *bb*, *cc*, *dd*, or wrapped with binding wire. After applying the soldering fluid, the piece is held over an annealing lamp and when sufficiently heated is touched with the end of a thin rod of solder which at once melts and unites the parts. In this way the minimum amount of solder may be applied.

For soldering larger parts of appliances, as in forming the Jackson cribs and springs, they should be secured in proper

position on the plaster model, and after applying the fluid and laying a piece of solder on the parts, the latter is melted and the parts joined with a soldering iron previously heated over a Bunsen burner. In soldering steel (as piano-wire) the fluid causes oxidation of the metal so quickly that it is important to heat the parts and melt the solder immediately after the fluid is applied.

Hard-Soldering.—Both the student and practitioner are supposed to be familiar with this process, so that few suggestions will be needed.

Parts of German silver appliances should be soldered with silver solder (silver 2, brass 1) while any of the compounds of gold or platinum may be united with either silver or gold solder. The latter when used should not be less than 18 karats fine to keep its color in the mouth. In joining articles with hard solder the parts to be united should be touched with the least quantity of liquified borax and only as much solder applied as is necessary.

After drying with moderate heat, the full flame should be directed upon the parts to be united and fusion accomplished as quickly as possible. Most of the hard-soldering required in constructing portions of regulating appliances may be done by holding the parts in the flame of a small Bunsen burner or alcohol annealing lamp. In other cases a larger flame with a blow-pipe to direct and concentrate it will be necessary, the parts being laid or secured in position upon a soldering block made of charcoal, asbestos, pumice-stone or other suitable substance.

When two solderings are necessary for the same piece, the first joint may be kept from unsoldering during the second process by placing an extra wire clip upon it or by seizing it with the tweezers at that point and thus protecting it from over-heating.

In soldering bands together as in Fig. 30, page 91, they may conveniently be held by means of the clip "*bb*," while a band and bar, as in Fig. 28, may be held in the same manner.

When two pieces of tubing are to be united at other than a right angle, they may be arranged and held in position upon the soldering block by being pinned down with staples made from piano wire. The end of one piece will of course have to be filed concave to fit the convex surface of the other, before joining.

Where it is desired to lengthen a traction screw, it may be done with less labor than constructing a new one, by cutting it in two at some point, inserting a new piece of like diameter, and uniting with solder. The parts may be held in position by being pinned to some smooth surface of the soldering block, or a groove may be made in the block with a straight piece of wire and hammer and the parts to be united laid into it. A wire may be shortened in like manner.

When a wire or a tube is to be joined to another at a right angle, they may be held as shown in "*hh*," which is also one of the best means for holding two flat pieces of metal for soldering, as in constructing a T appliance.

A screw cut wire may be fitted with a square end for turning with a key, by filing it to a smaller diameter and slipping over it and soldering a section of square tubing. If a shoulder is wanted in addition, a small washer or disk may be placed on the wire before the square tubing is adjusted. Both will be united at the same soldering.

Screws and Nuts.—The making of jack- or traction-screws and nuts to play upon them is an operation requiring care, but is not beset with much difficulty.

Jeweler's sets of taps and dies and the ordinary screw-plate are not very serviceable for our use, as the thread they cut is too fine (too many threads to the inch) and consequently liable to strip when much force is applied. The author has succeeded in having made a set of screw cutting appliances consisting of a die and adjustable die-holder for cutting screws, and two taps for threading nuts. They cut a clean, sharp and coarse thread, gauge .049 of an inch,

which is the single size found most suitable for regulating purposes. The set is illustrated at foot of Plate I.* It, with a bench or pin-vise, and a few tools such as files and pliers, together with a few sizes of jeweler's reamers, will furnish us with all the equipment we need for the purpose.

Screws.—The wire that is to be threaded or screw-cut, should be smoothly drawn and of moderate temper. The form that one end of the wire is to have may be given to it either before or after the thread is cut upon the other, but in most cases it will be well to fashion it first. The wire should be of exactly the same diameter as the hole in the die would be if the threads were removed. If smaller than this, a full, deep thread will not be cut, and if larger, the wire will be liable to be twisted off in the attempt. In cutting the thread, the wire should be slightly tapered at its end and grasped in the bench-vise, horizontally or vertically, with only about half an inch of its length protruding. To avoid marring the wire, the jaws of the vise should be provided with lead or brass caps.

The die (in holder) should now be held against the end of the wire at right angles to it and given a quarter or half turn with firm pressure. This should be repeated four or five times until the tool is well started in its work, care being taken to preserve the forward pressure and to see that the screw-plate is kept at a right angle to the wire. The operation may now proceed more rapidly until all of the exposed portion of the wire has been covered.

If a longer portion is to be threaded, more of the wire may now be exposed and the operation continued. A little oil fed to the tool will greatly facilitate the cutting. In reversing the operation to release the tool, care should be exercised not to mar the thread.†

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* It may be ordered from Geo. P. Pilling & Sons, 1225 Callowhill Street, Phila., from whom also all kinds and sizes of wire and tubing can be obtained.

† German silver wire of any size can be procured at electrical supply houses. The size best adapted for jack- and traction-screws is No. 17, (B. & S.) corresponding to hole No. 17 in the *Joubert* draw-plate.

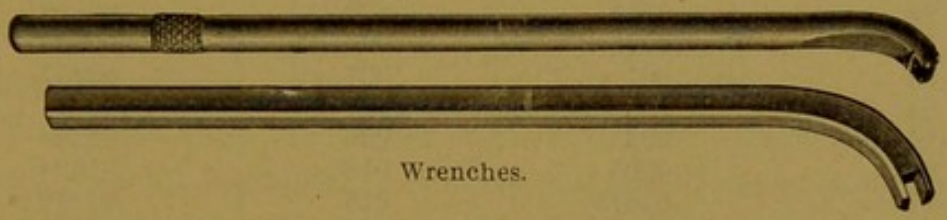
Nuts.—For use in regulating appliances, nuts should be square, about No. 13 in diameter, and not less than $\frac{3}{32}$ of an inch in length in order to have a good hold and resist the necessary strain. When greater strain than ordinary is to be withstood, they should be longer to prevent stripping of the thread. They should be made from heavy, square, German silver tubing, by sawing it into sections, grasping these in the pin-vise (*b*) and then drilling and tapping them.

FIG. 207.

Angle Drag-Screws.

In using the tap to cut the threads on the inside of these nuts, it should be oiled, held in a suitable holder and fed carefully with an alternate forward and backward movement to avoid clogging and danger of breaking the highly tempered tool.

FIG. 208.



Wrenches.

If the tubing from which the nuts are to be made has not been soldered after being drawn, it should be before it is cut into sections.

Fig. 207 shows the Angle form of drag-screws, and Fig. 208 two forms of wrenches most suitable for turning the nuts.

Comparative Table.

Showing Sizes of Wire and Plate in Decimals of an Inch by Various Wire Gauges.

No. of Gauge.	English Standard.	Stub's and Birmingham.	American Standard or Brown & Sharpe.
5	.220	.220	.18194
6	.203	.203	.16202
7	.180	.180	.14428
8	.165	.165	.12849
9	.148	.148	.11443
10	.134	.134	.10189
11	.120	.120	.09074
12	.109	.109	.08081
13	.095	.095	.07196
14	.083	.083	.06408
15	.072	.072	.05706
16	.065	.065	.05082
17	.058	.058	.04525
18	.049	.049	.04030
19	.040	.042	.03589
20	.035	.035	.03196
21	.0315	.032	.02846
22	.0295	.028	.02533
23	.027	.025	.02257
24	.025	.022	.0201
25	.023	.020	.0179
26	.0205	.018	.01594
27	.01875	.016	.01419
28	.0165	.014	.01264
29	.0155	.013	.01125
30	.01375	.012	.01092
31	.01225	.010	.00892
32	.01125	.009	.00794
33	.01025	.008	.00708
34	.0095	.007	.0063
35	.009	.005	.00561
36	.0075	.004	.005

In explanation of the above table it may be stated that the numbers in the first column refer to the numbers on the various gauge-plates, and their respective equivalents, in decimals of an inch, will be found in one of the other columns. Thus No. 17 of the B. & S. gauge is equal to .04525 of an inch, while No. 17 of the English standard is equal to .058, or a trifle more than .010 greater than that of the B. & S.

CHAPTER II.

ELECTRO-PLATING.

Electro-plating is the art of precipitating certain metals from their solutions by the slow action of a galvanic current. By this process the salts of the metals in solution are decomposed, the metal being deposited upon the object to be plated at the negative pole while acid is liberated at the positive one. Electro-gilding, or plating with gold, is employed in dentistry chiefly for the purpose of giving to appliances made from the baser or oxidizable metals a coating of finer metal (gold) that will resist the action of the fluids of the mouth.

Regulating appliances made from German silver or steel, in whole or in part, not only present a better appearance, but endure longer and operate more satisfactorily when properly gilded.

Piano-wire, so valuable and so largely employed in connection with regulating devices, not only becomes unsightly, but deteriorates when worn for a long time in the mouth. It may be bought electro-gilded, but the coating is so thin as not to be durable.

German silver, which is rapidly growing in favor for the construction of regulating appliances on account of its inexpensiveness and intrinsic merits, is also readily acted upon by the fluids of the mouth and the resultant oxidation greatly interferes with the operation of nuts and screws or the play of wires in their neatly fitting tubes. Gilding obviates all of these disadvantages and gives us the virtue of gold without its expensiveness.

German silver is easily gilded in either a warm or cold bath if its surface be first thoroughly cleansed; but steel, owing to its ready oxidability in the cleansing bath, does

not receive a good and durable coating of gold unless it is first plated with copper. Steel therefore requires to be subjected to two processes, while German silver or other alloys of copper need but one. Each of these processes will be described.

As a preliminary to plating, all articles must have a perfectly clean surface, otherwise the deposit will not adhere firmly to the object receiving it and the durability of the coating be greatly lessened.

During both processes of cleansing and plating, the article must not be touched with the fingers, as the slightest contact will prevent the adhesion of the metal at such points. To prevent this the article to be plated should have a copper or platinum wire attached to it at some point by means of which it must always be handled until the entire operation is completed.

CLEANSING GERMAN SILVER, BRASS AND OTHER COPPER ALLOYS.

The following is one of the best formulae for a cleansing solution:

Caustic potash,	1 lb.
Water, (soft)	1 gal.

Heat nearly to boiling point in a glass, porcelain or porcelain-lined dish, and suspend the article for a few minutes in the hot solution.

Remove and brush thoroughly upon a board, after which rinse well in clean water. If the article is soft-soldered at any point it must not remain in the lye too long or the solder will be acted upon.

CLEANSING STEEL.

Dip in the caustic lye used for copper, rinse thoroughly, scour with moistened pumice, rise again and pass through the following dip:

Sulphuric acid,	1 part.
Water,	20 parts.

After this the article must again be well rinsed before being placed in the plating bath.

COPPER SOLUTION.

The electro deposit of copper is usually obtained by the decomposition of acetate of copper and cyanide of potassium.

A good bath or solution is as follows:

Water, (soft)	1 gal.
Acetate of copper, (crystals) . . .	3½ ozs.
Carbonate of soda, (crystals) . . .	3½ ozs.
Bisulphite of soda, ...	3 ozs.
Cyanide of potassium, (pure) . . .	7½ ozs.

Moisten the copper salt with water to form a paste, (otherwise it is apt to float on the liquid); stir in next the carbonate of soda with a little more water, then the bisulphite, and finally the cyanide with the rest of the water.

When solution is complete, the liquid should be nearly colorless. If not, add cyanide until it is.

This bath may be used either hot or cold.

An immersion of a few minutes will usually furnish a sufficient coating of copper when the article is afterward to be gilded.

GOLD SOLUTION.

Formula:

Chloride of gold, ...	72 grs.
Cyanide of potassium, (pure) . . .	1½ ozs.
Water, (distilled)	30 ozs.

Dissolve the cyanide in part of the water, then gradually add the gold chloride* dissolved in the remainder. Boil for one-half hour and use cold. The solution prepared as above should be colorless after standing awhile, and the color of the deposit should be yellow. If black or dark red, add more cyanide dissolved in water. If cyanide be in excess, plating will proceed slowly or not at all; in such case add more gold chloride or increase intensity of current by im-

*Chloride of gold can be purchased at chemical supply houses.

mersing zincs deeper in cell. In gilding German silver, the best results are obtained when the bath is kept slightly warm.

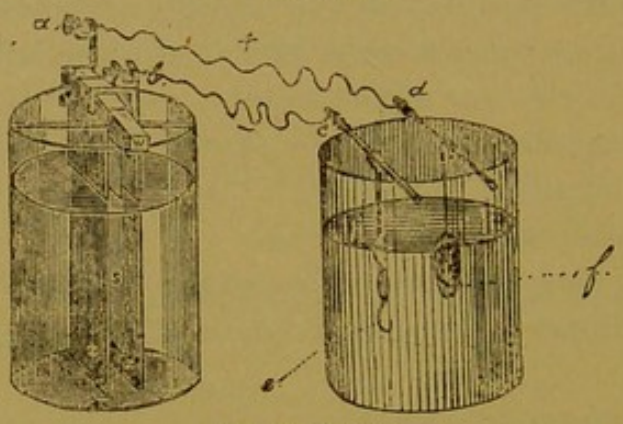
All gilding baths should be stirred occasionally to destroy the gravity of the liquids.

BATTERY.

For small articles, such as regulating appliances, a single cell (Daniel or Smee) will give us sufficient intensity of current.

Fig. 209 represents a simple battery composed of a single Smee cell connected with the jar containing solution and articles to be plated.*

FIG. 209.



Plating Battery.

In the illustration of the battery, "*z*" represents the zinc plates and "*s*" a strip of platinized silver suspended between them. "*w*" is a wooden support which rests upon the edges of the jar with the silver strip let into its under surface. "*b*" is a clamp connecting the two zinc plates on the outside of the wooden support, while clamp "*a*" connects with the silver strip. The plating or bath jar has two copper rods resting upon it, one of which "*d*" has the metal anode suspended from it by means of a platinum or copper wire, while the other "*c*" has the cathode or article to be plated similarly suspended.

The battery jar or cell is charged with a solution of one part of sulphuric acid to ten parts of water. The current

*A Smee cell with platinized silver plate can be bought at any electrical supply house for $3.50, and additional plain glass jars, one for copper and the other for gold solution, for about 15 cents each.

generated by the action of the acid solution upon the zinc plates passes through the positive (+) wire to the rod "*d*," into the plating solution by way of the anode (*f*), across to the cathode (*e*) and back to the battery by way of the negative wire (−). The current in its passage decomposes a portion of the gilding solution and causes the metal thus set free to be attracted to and deposited upon the article to be plated.

The solution being thus deprived of a portion of its constituent salt, in turns acts upon the suspended anode and takes from it a sufficiency of the metal to restore its former equilibrium. In this way, as each article is coated with the metal, the suspended anode is eaten away to replace the loss and the solution suffers no great diminution of strength. The anode for copper plating consists of a piece of sheet copper, while for gilding, the anode should be of pure gold and can be made by melting gold foil scraps into a button and then hammering it into a thin sheet. All anodes should have perfectly clean surfaces in order that they may be readily acted upon.

PLATING.

With the battery in position and the jars filled to within about two inches of their tops with their respective liquids, the operation of plating is a very simple one. After the article to be plated has been made smooth and polished and properly cleansed in the cleansing solution, it is rinsed in water, and if other than steel, is immediately suspended in the plating solution from the copper rod "*c*." The corresponding anode is hung upon the other rod "*d*," when the deposit of metal at once begins. The length of time necessary to secure a good coating will vary somewhat with the strength of the solution, the intensity of the current and the metal to be plated. Usually from ten to twenty minutes will be sufficient, but a little practice will be necessary to determine the time and secure the best results. If

on removal the deposit is found to be too light, the article can again be placed in the bath and more added. When finally removed from the bath it should be held in running water and then dried.

If the article has a dead finish when placed in the bath, it will present a similar appearance when plated. If polished in the first instance, the deposit will have a polished appearance provided the current be not too strong.

The process of plating steel differs from the one just described in requiring the article to be dipped for a moment in the sulphuric acid solution after it comes from the cleansing solution and before it is placed in the copper plating bath. After receiving a fair coating of copper it is washed and then placed in the gold bath and gilded as described.

The deposition of the metal in any case usually progresses more quickly and evenly when the article to be plated is separated by about two inches from the anode and is slightly agitated while in the bath.

When the battery is not in use the anode should be removed from the plating solution and the zincs be elevated above the liquid in the battery. Both jars should also be covered to protect them from dust.

Plating without a Battery.—A simple method of gilding metallic articles is by the use of so-called *gilding solutions.* These preparations consist of gold dissolved in an acidulous liquid and the deposit takes place when the article to be plated is placed in the solution by the side of and touching a piece of clean zinc. The latest claimant for favor, among this class of preparations, is Pohlman's Gilding Solution. All of them will give a coating of gold to the article placed in them, but the coating is very slight (unless the operation be repeated several times), and they are in no wise as satisfactory as the battery plating previously described.

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