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ORIGINAL COMMUNICATIONS.

"BONE-GROWING."

By EDWARD H. ANGLE, M.D., D.D.S., New London, Conn.

(Read at the fourth annual meeting of the Alumni Society of the Angle School of Orthodontia, New York, N. Y., November 1908.)

DOUBTLESS you will be surprised at the title of my paper, and you will ask what bone-growing has to do with orthodontia. My answer is that it is probably the most important problem in orthodontic treatment. Indeed, most of our successes in treatment depend on our success in bone-growing, and if the orthodontist does not succeed in growing bone he will find, in time, that the teeth he has moved so dextrously and satisfactorily have all returned to, or very nearly to, their original positions. For this reason the branch of science which Dr. Noyes teaches us—histology—when it is understood and its relation to orthodontia really comprehended, will probably be accepted as the most important of any subject in the orthodontic curriculum, because it has so largely to do with the science of bone-growth.

Let us remember that malocclusion of the teeth is always associated with a lack in the growth of bone, or the perverted growth of bone, in degree corresponding exactly with the degree of malocclusion. Nature attempts to build a denture, a face, a skull, and all other parts of the anatomy to be in accordance throughout with a type she has designed for the individual; but for some reason some of her processes in the building of the different parts may have been interfered with. The result, as we find it, is perversion or arrest in the growth of the alveolar process, jaws, and associate bones, and malocclusion.

Dr. Noyes has again and again tried to impress us at the school with the fact that "bone grows as a result of mechanical stimuli," and I would ask you to keep his "creed" in mind.

Now, in order to grow bone, the orthodontist depends on the increased stimulus given to the bone-cells by the more normal functionating of the teeth as a result of the establishment of normal occlusion. This stimulus, plus that given by the establishment of the normal functionating of lips and tongue, will, in favorable conditions, as we have recently learned, result in marvelous changes in the growth of the bone, and yet these stimuli are apparently not enough in many cases to bring about such results in bone-growth and development as we would wish.

Fig. 1.

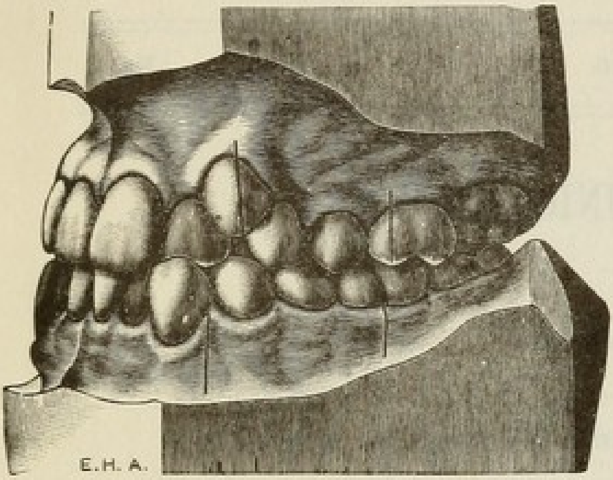
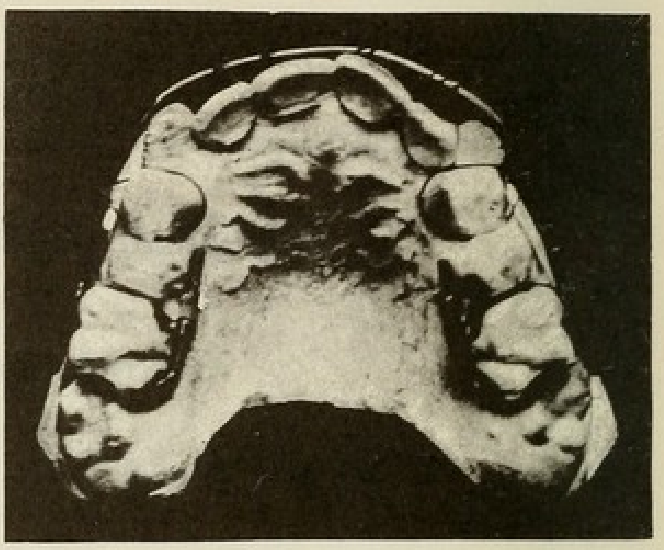


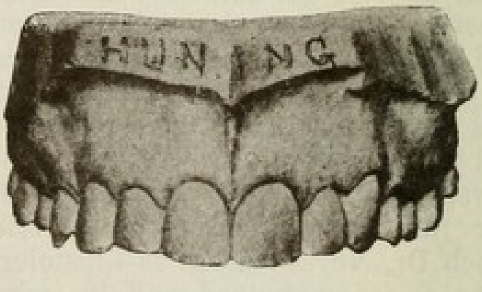
Fig. 2.



To make this point clear, let me go back a little in the history of orthodontia.

You know that orthodontia had long been burdened and seriously handicapped by the belief that small jaws and large teeth had in some mysterious way become mixed up through heredity, resulting in malocclusion. Following this, logically, was the necessity for extraction in treatment in order to harmonize the disparity in size between the jaws and teeth. Of course we had long known that there was some little bone-growth as a result of tooth movement, supposing it to be limited chiefly to the alveolar process over the gingival half of the roots of the teeth, and that as a tooth was tipped into upright position the bone in front of it was absorbed, and on the opposite side of the moving tooth bone was built in, and it was thought that mechanical support of the teeth was only necessary until this building-in of bone was complete. You have all read this a hundred times in the old writings, and well remember how it was illustrated by a picture of a leaning post which had been driven into the ground, being tipped to upright position. But that as a result of the establishment of normal occlusion and the forces incident thereto there would be given such a stimulus to bone-cells and other tissues as would cause nature to develop bone on a large scale, complete the full growth of the alveolar process, shift the very apices of the roots of the teeth to their proper positions labially and buccally, remodel completely the form of the vault of the arch, the floor of the nose, the size and proportions of the maxillary bones, and probably all other bones of the face, was not realized. So I think the happiest moment of my life in connection with orthodontia was when I discovered in the case shown in Fig. 1 that nature would do these things, and I believe that the pictures represent-

Fig. 3.



ing this case have the greatest historical value of any pictures in orthodontic literature. I want you to note the pronounced lack of development of the bone, especially in the region of the roots of the incisors. And this is not an unusual case by any means—you have seen hundreds of similar ones, both in regard to malocclusion and lack of bone-growth.

Fig. 4.

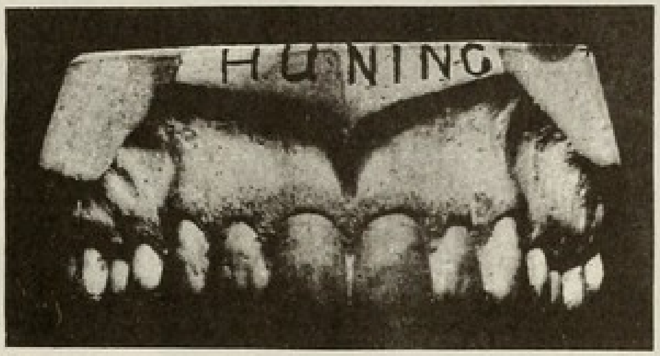
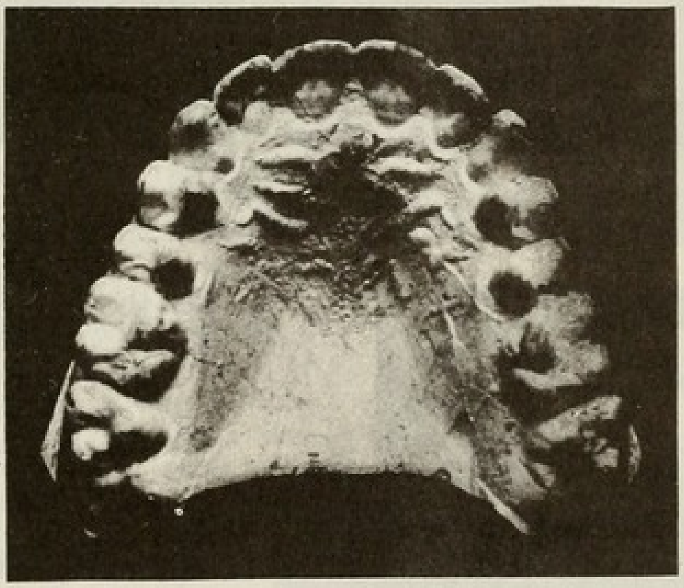


Fig. 5.



I will not take time now to point out the difference in millimeters between the bone-development here and in the completed case (Figs. 4 and 5), but you will readily see in a general way how pronounced these changes are.

The second picture (Fig. 2) shows the occlusal aspect of the teeth, and you will see how greatly the arch is diminished in size, and how narrow and deformed is the vault of the arch—another instance of "the large teeth of one parent and small jaws of the other," you know—plainly demanding extraction. But I could not bring myself to the point of sacrificing any of those remarkably beautiful teeth. Instead, the crowns of the teeth were tipped labially and buccally to approximately their normal relations with the line of occlusion, but the resultant pronounced angle of inclination of the incisors, on account of the great arrest in the development of the alveolar process and intermaxillary bones, as shown in Fig. 3, often made me doubt as to whether I would ever be able to maintain the crowns of the teeth in their corrected relations. But the teeth being in occlusion and their normal functionating established, after two years of faithful retention I found the remarkable changes to have taken place that are

Fig. 6.

Fig. 7.

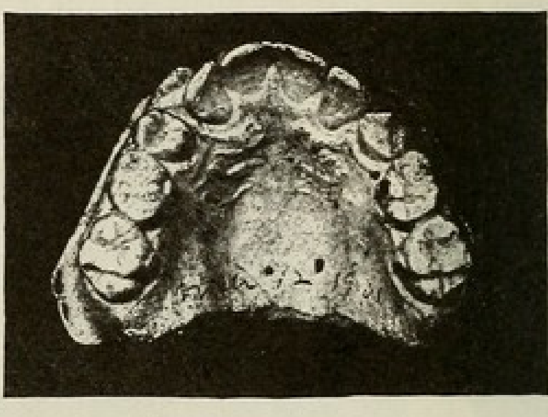


Fig. 8.

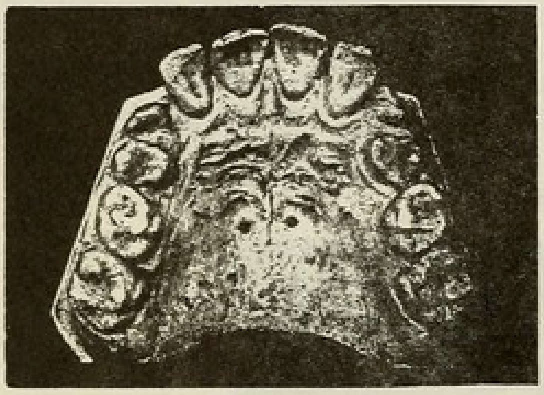


Fig. 9.

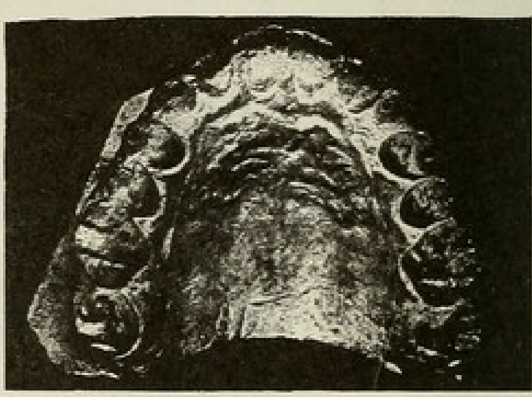
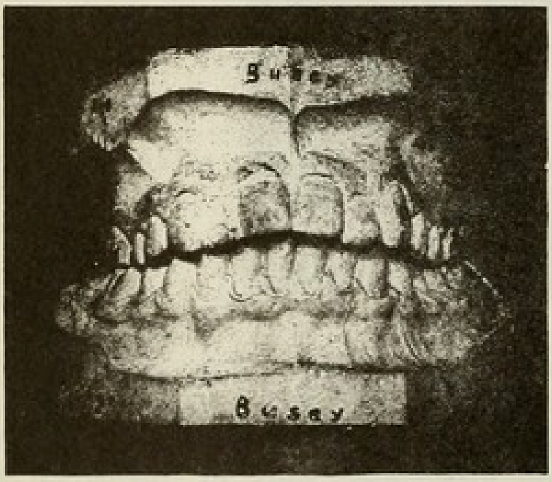


Fig. 10.



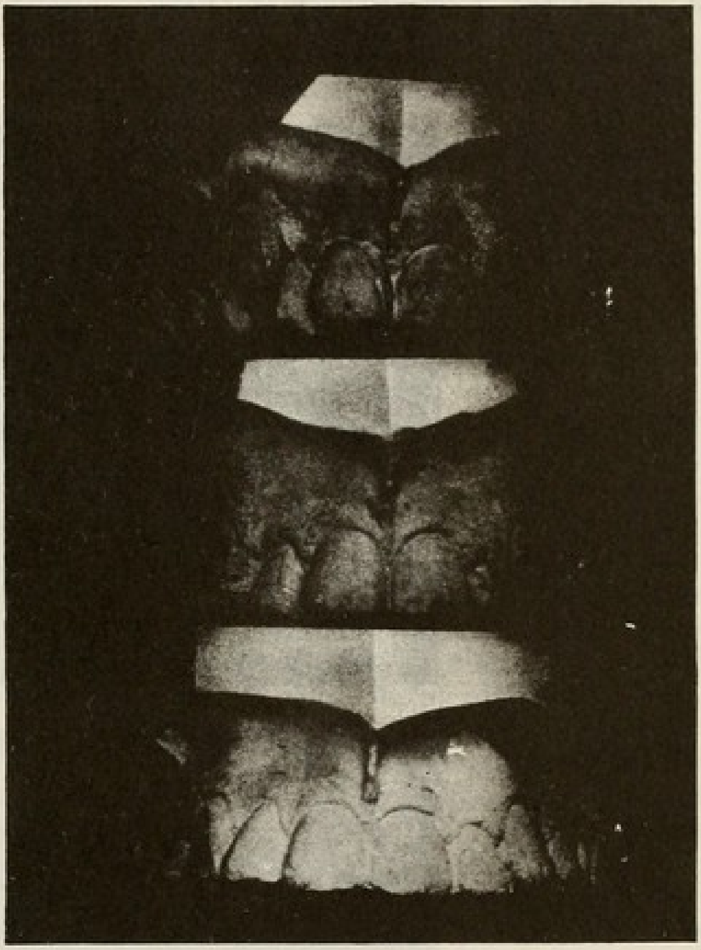
shown in Figs. 4 and 5, and you can well imagine my joy, for I knew that here was a law that would apply in all such cases—that the time-honored saw of the mismating of jaws and teeth was here plainly proved to be a myth, a snare, and a delusion, and that extraction in such cases was no longer necessary but reprehensible, for it meant not only seriously and permanently deforming the dental apparatus, but the face as well. This latter fact I later brought out in a paper, "Art in Relation to Orthodontia" (published in *Items of Interest*, September 1903, page 646), with which you are all familiar.

But the story that these pictures tell, none of you yet fully appreciate. In fact no attention was paid to it when it was first brought out, and not until long afterward.

Let it be remembered that the growth of bone in this case took place under favorable circumstances, a healthy child at the age of eleven years, yet difficult retention for more than two years was required to effect the changes shown. And another case, shown in Figs. 6, 7, 8, 9, and 10, where the greatest amount of bone-building has followed tooth movement of any case so far reported, required three years of retention at a most favorable period of life.

In the very great tissue changes that have taken place in all such cases as those just described, it must be apparent that there is a vast amount of tearing down of bone by the osteoclasts and its rebuilding by the osteoblasts, as well as similar cellular and structural changes of the other tissues involved. Very naturally—and this is a fact proved by experience—these changes are most active and the growth of bone most pronounced in cases treated during the active period of growth and development of the dental apparatus, this activity diminishing with advancing age, necessitating longer periods of retention as the patient nears maturity, and after maturity the development is very slow and is never complete, as shown in the case in Fig. 11, in which the period of retention had covered four years.

FIG. 11.

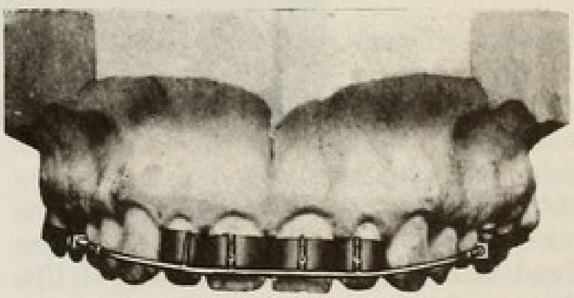


THE "WORKING RETAINER."

With a view of expediting the treatment of malocclusion by shortening the period of retention in these cases, the writer has devised a method of retention by which he believes the cells involved in these tissue changes will be gently stimulated to greater and longer activity, with the more speedy and complete development of the tissues.

The device is shown in Fig. 12, and has for its purpose not only to support the crowns of the teeth in their corrected relations with the line of occlusion, but at the same time to exert a very gentle but constant force labially on the roots of the incisors. It may be regarded as a "working retainer," as appropriately named by a former student of the writer, Dr. George B. Palmer.

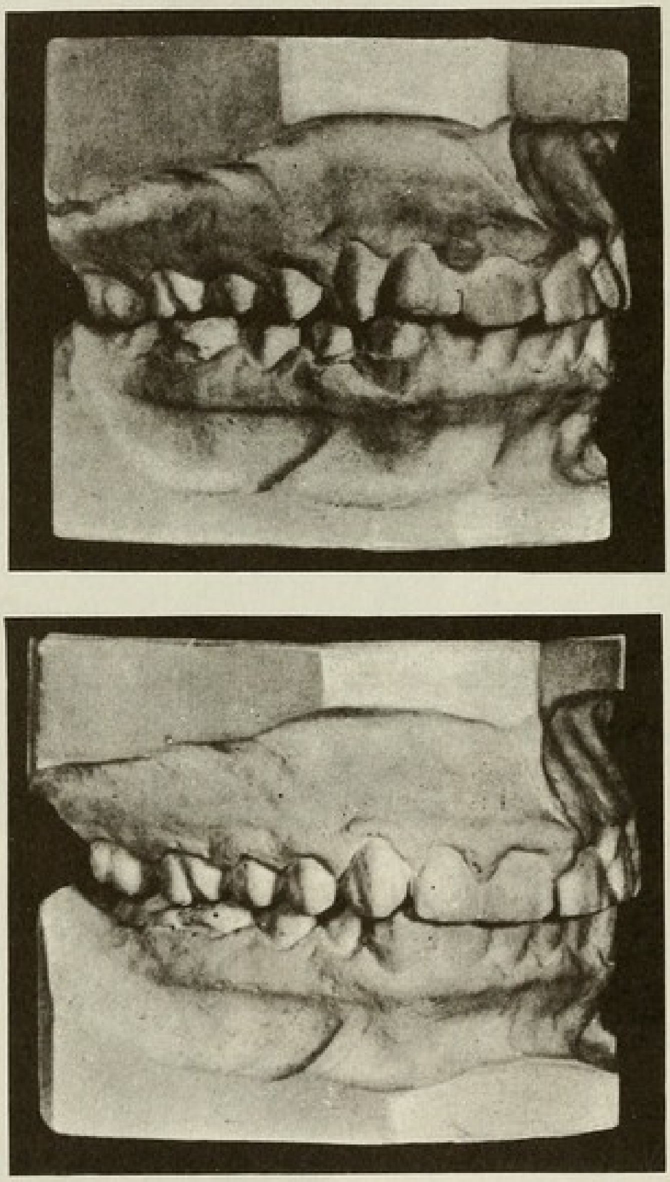
FIG. 12.



The publication of this device has been

delayed so that its usefulness might be practically demonstrated, and this was done first by Dr. A. H. Ketcham, in the case shown in Fig. 13—reported at the fifth annual meeting of the Alumni Society of the Angle School of Ortho-

FIG. 13.



dontia, December 1909—in which the very gratifying results shown were obtained after six months' wearing of the device.

The device is made by removing the segment between the threaded ends of the expansion arch that has been employed in accomplishing the movement of the teeth, and substituting for it a segment, of the same length and curve, of very delicate and elastic iridio-platinum and gold wire, twenty-nine thousandths of an inch in diameter, attaching the ends of this wire to the threaded ends of the original arch with twenty-two karat gold solder. Very small tubes are soldered perpendicularly to the labial surfaces of delicate iridio-platinum bands previously very carefully fitted to the crowns of the incisors. These tubes must be parallel with each other, their incisal ends resting in contact with the middle segment of the arch.

Very delicate spurs, of the length and

diameter of the bore of the tubes, or twenty-two thousandths of an inch, are soldered to the arch at points opposite the mouths of the tubes and at angles exactly corresponding to the bore of the tubes when the arch is in position. The ends of the spurs are then gently inclined forward about three thirty-seconds of an inch by bending, the arch replaced upon the teeth, and the spurs sprung into the tubes. Thus a gentle force from the elasticity of the spurs and arch combined is given to the roots of the teeth in a labial direction, while the crowns are given stationary support in all directions.

The writer believes that such a gentle, harmless stimulus is thus given as will accelerate cellular activity and greatly lessen the time usually necessary for bone-growth and retention, besides effecting final results in bone development which would otherwise be impossible when the patient is nearing maturity.

As the alveolar process is developed and the apices of the roots of the teeth are moved labially, it is occasionally necessary to renew the force by further outward bending of the spurs, and in order to avoid the necessity of removing the arch and the possible accident of its being unfavorably bent, the writer recommends that a portion of the center of the tubes be removed with a round file, as shown in the illustration. This arch may then be sprung slightly downward, the ends of the spurs caught with a delicate excavator where the tubes are cut away for the purpose and given the necessary bend, then the spurs sprung back into position. This, however, should not be done oftener than once in one or two months.

By studying the possibilities of this device it will be seen that we have absolute control over the development of the positions of the teeth in their entirety, far more so than by the use of any other known retaining device. First, the most perfect support is given to the crowns of the teeth in all directions; second, the crowns may be shifted labially or lingually by tightening or loosening the nuts in front of the anchor bands; third, the positions of the roots of the teeth may be developed labially or lingually, mesially or distally, by a gentle force from the proper bending of the spurs, independent of the active or passive retention of the crowns of the teeth; fourth, force for rotation or for the prevention of rotation of any of the teeth may be given by partially flattening the ends of the delicate spurs and the ends of the tubes in which they are engaged, then giving the spurs a slight twist and re-springing them into position; finally, all of the teeth may at the same time be lengthened or shortened, if so desired, by giving the necessary downward or upward spring to the segment of arch.

Of course, in like manner support and movement may be given to the canines and premolars, and by drilling through the sheaths of the tubes of the anchor bands and the sides of the threaded portion of the arch and inserting delicate keys therein, force may be exerted through the elasticity of the arch for the movement of the molar roots, either buccally or lingually.

In making use of this device the arch may be placed above the tubes instead of below them as shown, or, in favorable cases where the occlusion will permit, the arch may be placed lingually to the teeth, with the tubes either parallel with or at right angles to the long axes of the teeth; but all things considered, the position given the device in the illustration will be found to be the most satisfactory.

It is also equally applicable to the lower dental arch.

Of course the device may be operated either as a regulating or retaining appliance, or both, as its name implies, but the writer believes its greatest usefulness will be as a bone-stimulant, and when so used it should be very delicate, as described, so that only such gentle force will be given to the roots of the teeth as to physiologically stimulate the bone-cells. Great force and rapid movement of the apices of the roots of the teeth the writer believes to be unphysiological.

THE

DENTAL COSMOS.

VOL. LIV. AUGUST 1912. No. 8.

ORIGINAL COMMUNICATIONS.

EVOLUTION OF ORTHODONTIA—RECENT DEVELOPMENTS.

By EDWARD H. ANGLE, M.D., D.D.S., New London, Conn.

(Read before the Alumni Society of the Angle School of Orthodontia, Sept. 13, 1911.)

THE expansion arch, since its introduction in 1728 by the great French dentist, Fauchard, has undergone a number of modifications, some showing progress, others showing merely differences without progress, others marking steps backward, and still others representing mechanical absurdities.

THE EXPANSION ARCH FROM ITS EARLY TO THE PRESENT FORM.

The principle of the arch has not been changed, but its improvements have been toward its refinement, so that in its present form better control of the distribution of force has been gained, not only for the movement of malposed teeth, but in securing stability of anchorage. The result has been to enormously increase its efficiency and to greatly lessen its inconvenience to the patient.

The Fauchard arch is shown in Fig. 1, and some of the principal modifications of it appear in Figs. 2, 3, 4, 5, and 6.

In its early forms this arch was very crude and inefficient, and, in its attachment to the anchor teeth by means of fibrous ligatures, very unstable in comparison with its present almost ideal form of attachment by means of the easily adjusted, securely clamped anchor bands, with their tubular sheaths firmly brazed to the band at the most convenient point. By this means the firmest attachment of the arch to the teeth is secured, and the strongest attainable anchorage—stationary anchorage—gained.

The early forms of the arch, *i.e.* flat, square, or half-round, have been changed to the most compact, sanitary, and elastic form, *i.e.* the round form.

The crude methods of controlling the adjustment of the arch as to size have been supplanted by the ideal method, the screw, and to the screw has been added as a valuable improvement the friction-sleeve nut, which in the most simple manner effectually prevents the accidental unturning of the nut, besides reducing the bulk of its square, exposed portion to the minimum, and consequently lessening the inconvenience to the patient.

Another step of almost inestimable value in the use of the arch is the more perfect control of the force for moving teeth gained by the change from fibrous to metal ligatures. The fibrous ligatures involved much loss of power through slipping and stretching, necessitating their frequent removal and replacement by others, causing the springing backward and forward of the tooth in its socket, greatly disturbing the cellular structure of the pericementum, and al-

Fig. 1.

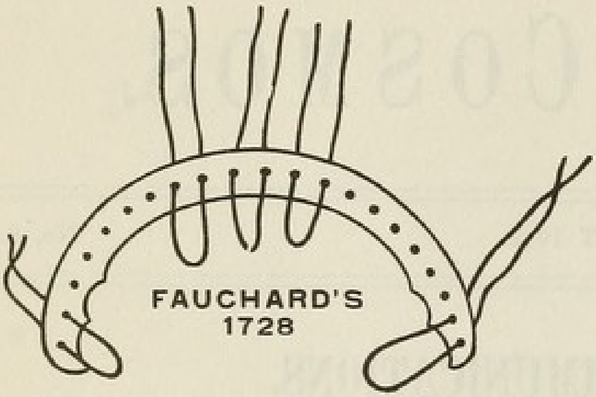


Fig. 2.

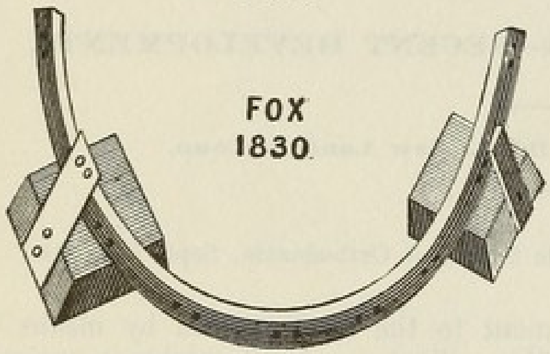


Fig. 3.

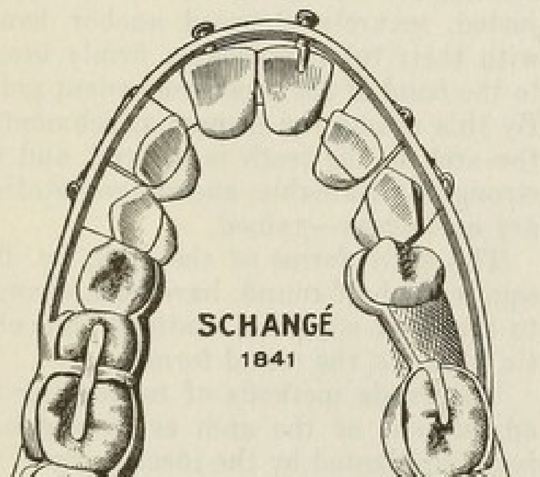


Fig. 4.

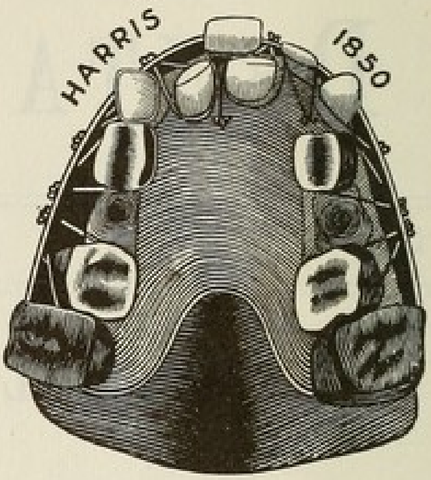
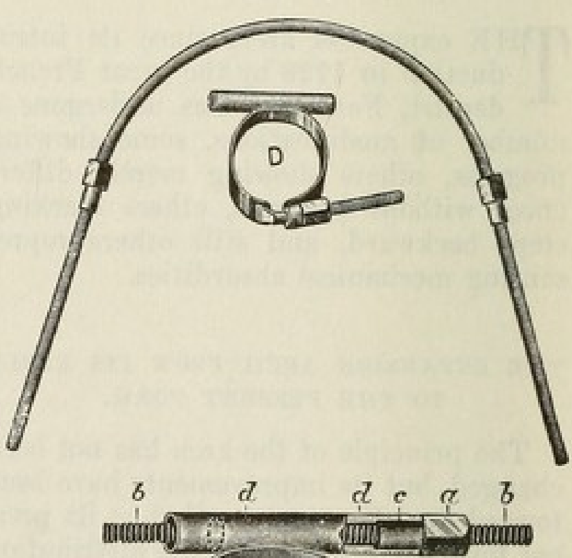
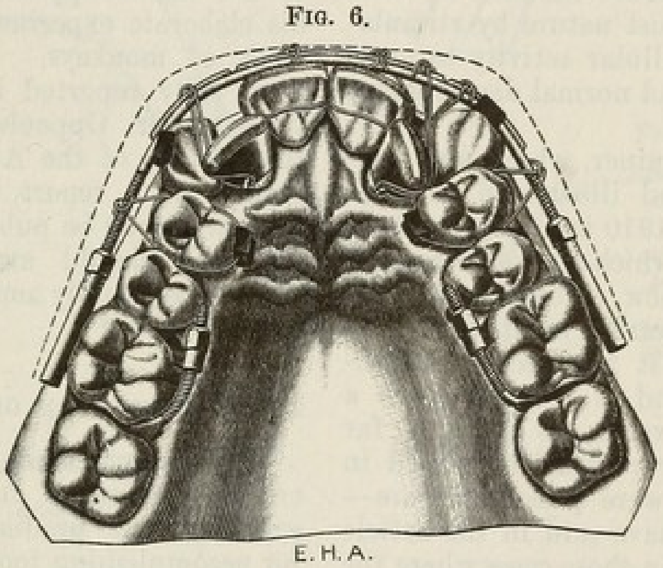


Fig. 5.



ways inciting inflammation and pain in proportion to the frequency of these disturbances, while with the use of a soft, tough wire ligature—one of brass being the best—loss of power through stretching or slipping is practically eliminated, and what is of great importance, much time is thereby saved for both patient and orthodontist. The wire ligature may also be tightened by additional twists, thus avoiding the necessity for its frequent renewal and greatly lessening tissue disturbance, inflammation, and pain.

Fig. 6.



E. H. A.

So the expansion arch in its present form, with its auxiliaries, constitutes an orthodontic appliance so simple and efficient that it is nearly the ideal, and has very largely displaced all other forms of appliances for tooth movement. With it we have the most perfect control of the anchorage, and very perfect control of the force on the moving teeth, individually and collectively, for *tipping* their crowns into proper relationship in the line of occlusion. Little wonder, then, that it has become the chief reliance of orthodontists and a very important factor in the wonderful progress that orthodontia has made in the past few years. So efficient is it that for a number of years it seemed to the writer that its further improvement was not only unnecessary, but perhaps impossible. Continued research, however, and broader experience later convinced him that still further steps in its evolution were desirable, and probably possible. To comprehend this clearly let us remember that by the manner in which the expansion arch is now used, Fig. 6, the crowns of the teeth only are moved, or tipped, into position, with little or no favorable movement of the apices of their roots, which often leaves the teeth, after their crowns have been brought into proper relations, at a very pronounced and abnormal angle of inclination, and this just in proportion to the degree of the previous arrest in the development of the alveolar process and the bones involved. While we have learned that, as a result of the function of mastication, through the establishment of normal relationship of the crowns of the teeth, nature will be stimulated under favorable conditions to complete the development of the bone and to shift the roots of the teeth bodily to their normal upright positions, yet this often involves much time, requiring long and tedious periods of retention. Indeed, experience has proved that the degree of our success in the treatment of cases of malocclusion depends largely on the degree to which nature can be induced to complete the development of the under-developed bone, and that the measure of this bone development depends greatly upon the age and vigor of the patient. It was soon observed that this activity in bone development was greatest in youth, or during the period of the eruption of the teeth, and that it diminished perceptibly toward maturity and after.

"BONE-GROWING" AND THE "WORKING RETAINER."

It then occurred to the writer that the retaining device should, if possible, be so constructed as to operate not only for the support of the crowns of the teeth in their corrected positions, but also to exert gentle pressure outward on their roots, and thus assist nature by stimulating the osseous cellular activity to more rapid, complete, and normal development of the bone.

The working retainer, which was carefully described and illustrated at page 265 of the March 1910 issue of the DENTAL COSMOS, and which we would request the reader to review carefully, was the result, and so successful was this method of retention that it has become an accepted practice and is recognized as a factor of much value, as with it far quicker and better results are gained in many cases than were possible before—especially, as we have said in the article above referred to, in those cases where the most active period in the development of bone had passed.

From this step the writer reasoned that our very plan of *treatment* might be greatly improved; instead of tipping the crowns of the teeth into the line of occlusion and leaving the roots at abnormal angles of inclination, to be adjusted by nature during the period of retention, the teeth should be moved bodily, *as a result of force so gentle and so evenly distributed as to stimulate normal cellular activity and the growth of bone.* In other words, the work of the orthodontist should be the intelligent assisting of nature in her process of developing bone, thus making it possible for her to normally build the denture in its entirety. When the proper assistance has been rendered and the normal growth and development of the bone and other tissues accomplished, all other conditions being favorable, the work of the orthodontist should be at an end, thus eliminating entirely the usual tedious period of retention, with its attendant difficulties and annoyances.

That tooth movement is performed more easily, more satisfactorily, and with better results when very gentle pressure, rather than pronounced force is employed, has for a number of years been becoming more and more apparent to the writer, and the correctness of this belief has now been abundantly proved by the recent remarkable research work of Dr. Albin Oppenheim of Vienna, in his elaborate experiments in moving the teeth of monkeys. These experiments were fully reported in a course of lectures by Dr. Oppenheim at the session, just closed, of the Angle School of Orthodontia; a report of these investigations will soon be published in this country, and should awaken the greatest interest, especially among histologists and orthodontists.*

AN IMPROVED FORM OF EXPANSION ARCH.

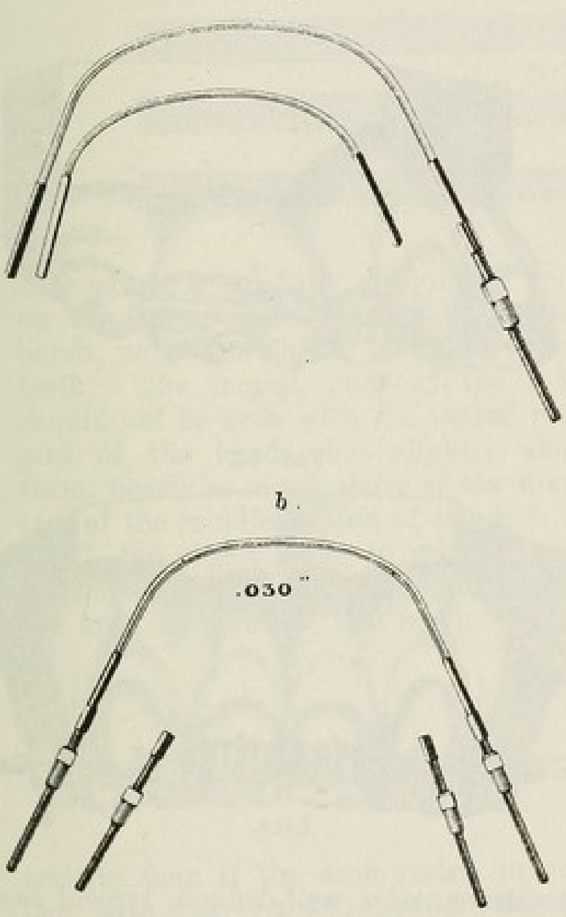
Experiments made by the writer, covering a period of four years, have resulted in the production of appliances for accomplishing tooth movement in accordance with the plan above suggested. These appliances consist of an expansion arch of further modified form, with auxiliaries and attachments. Fig. 7 shows the modified arch. It will be seen that it is divided into three parts, a middle section and two end sections. The end sections are threaded and provided with friction-sleeve nuts. The middle section is smooth, with squared ends, which accurately telescope for a distance of about one-eighth of an inch in square sockets in the anterior ends of the threaded sections. One of the advantages of this form of arch is that the middle section may be of any length or diameter desired, and as a result of many measurements of models, three lengths and three diameters of each length are found to amply provide a most convenient range of size

* See *American Orthodontist*, October 1911.

and strength for all dentures, from the smallest to the largest, thus fully meeting all requirements in practice. All middle sections, of whatever length or diameter, are accurately interchangeable with the threaded sections, which are of the same diameter as the threaded portions of the writer's standard expansion

FIG. 7.

a



arches E, the friction-sleeve nuts being adapted to the writer's standard D bands, Fig. 5.

The three diameters of the middle sections are forty-five thousandths of an inch, thirty-eight thousandths of an inch, and thirty thousandths of an inch (.045", .038" and .030"). (See Figs. 8, 9, and 10.) The arches of heavier diameters, that is, .045" and .038", are intended to be used in connection with wire ligatures in precisely the same way as the standard expansion arch E, which has so long been familiar to all. These heavier middle sections are made in both precious metal and nickel-silver, as are also the threaded sections.

FIG. 8.

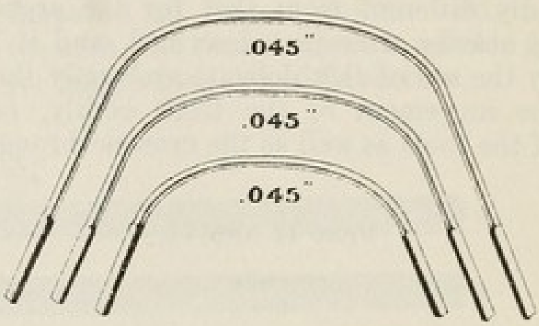


FIG. 9.

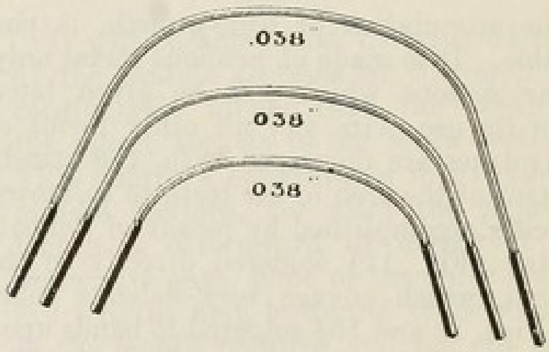
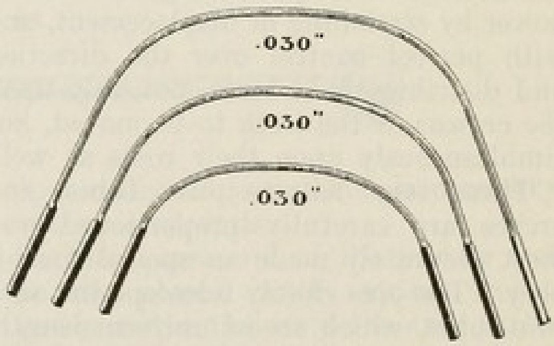


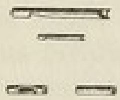
FIG. 10.



THE .030" DIAMETER ARCH AND ITS APPLICATION.

To those already familiar with the expansion arch E, any further description of the larger diameters of the middle sections of the new arch in regard to their use in connection with the clamp bands, wire ligatures, etc., seems unnecessary; the use of the two forms of appliance and the manner of their operation is identical, but the greater convenience of the new form readily suggests itself. The manner of using the delicate arches of .030″ diameter, however, is unique, and the plan of operation radically different from that for the arches of heavier sizes just described, and it is by the use of this delicate arch only that the movement of the teeth bodily, *i.e.* of the roots as well as the crowns through the stimulation of bone-growth, is possible. It is made of precious metal only, for reasons which will be given later. In its use, wire and all other forms of ligatures are dispensed with, the attachment of the arch to the teeth to be moved being accomplished by means of delicate pins (Fig. 11) soldered directly to the arch, which engage very delicate tubes (Figs. 12 and 15) soldered to bands upon the teeth to be moved, as shown in Fig. 13, insuring the most firm and compact attachment with practically no loss of power by stretching or displacement, and with perfect control over the direction and distribution of force, not only upon the crowns of the teeth to be moved, but simultaneously upon their roots as well.

FIGS. 11 AND 12.



These very delicate pins, tubes, and arches are carefully proportioned and most accurately made on special machinery. The pins closely telescope the delicate tubes, which are of uniform length, diameter, and bore. One end of the pin is made in the form of a hook, which accurately fits the bevel of the end of the tube when the pin is in place in the tube. It is of the greatest importance that this hook shall not be dulled and thus rendered ineffective. The orthodontist should study its proper locking and unlocking, to avoid injuring it. The other end of the pin has the form of a minute fishtail, with a knife-edge crescent for convenience in attaching the pin to the arch with solder. A portion of the outer wall of some of the tubes is seen in Fig. 12, to be cut away in crescent form. This is not necessary, but will often serve as a convenience by giving access to the pin for its bending without wholly removing it from the tube.

Mode of applying arch in a typical case belonging to class I. In the following we shall describe the adjustment and operation of the new appliance for the treatment of a well-defined, typical case belonging to class I (writer's classification), a model of the upper jaw of which is shown in Figs. 13 and 14.

FIG. 13.

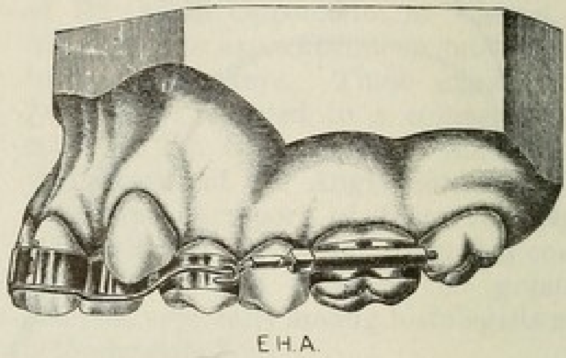
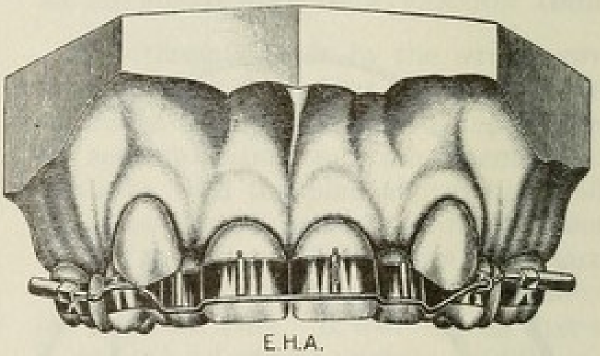


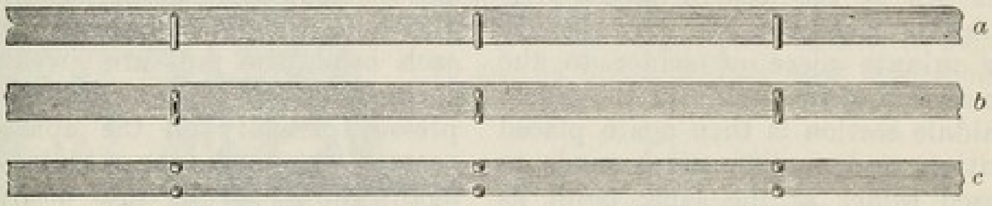
FIG. 14.



The anchor bands are carefully adjusted to the first molars, with the tubes properly aligned. The screw sections of the arch are then inserted in the tubes, and the extension flange of the nut is adjusted within the friction sleeve of the sheath of the anchor band. Accurately fitting plain bands of either precious metal or German silver are placed upon all the incisors, the seams to be made on the lingual surfaces so that the labial surfaces will present even, uniform margins. The bands on the centrals should, whenever possible, be of the same height, while those on the laterals should be uniform in height and alignment, but should occupy a plane nearer to the gingiva than the bands on the centrals, so that the distance between the margins of the bands and the cutting edges of the teeth will be the same on the laterals as on the centrals. A delicate tube is then soldered at a carefully designated point on the labial surface of each of these bands, parallel with the long axes of the teeth. The incisal ends of the tubes should not be even with the incisal margins of the bands, but slightly above them, nearly as much above as the diameter of the middle section of the arch, or .030″, the object being to provide space on the band below the tube against which the arch may rest. The result is more artistic than if the arch rested in contact with the enamel; besides, the appliance is more cleanly and compact. The gingival ends of the tubes, of course, project correspondingly above the margins of the bands.

A middle section of the .030″ diameter arch is now selected from the three lengths shown in Fig. 10. In order to determine the proper length of this section, a piece of heavy brass ligature wire is used, one end of it being placed in the square hole of the end of one of the screw sections, the wire then being bent to conform accurately to the buccal and labial surfaces of the teeth, and the bends being made sufficiently sharp so that the wire will lie closely against the labial (or buccal) surface of each tooth. The wire is then cut off, leaving a sufficient length to engage the square hole of the other screw section. The wire is then straightened and curved to correspond in shape to an unused middle section of the arch. It thus becomes a reliable gage for length for the middle section.

FIG. 15.



It will be noted that the squared ends of the middle sections of the arch are considerably longer than the depth of the square sockets in the screw sections. This affords a convenience in fitting the middle sections, for after the required length is determined by means of the brass wire gage, none of the three standard lengths may be found to be exactly of the length required, but the one most nearly approaching it may be shortened by cutting off as much as is necessary of the squared ends.

FIG. 16.

One square end of the middle section is now placed in the square socket of one screw section, and the arch carefully bent (as was the wire gage before it) with a pair of delicate round-nosed pliers of special form until it rests at the desired point on the end of the first tube. It is then notched with the most delicate knife-edge file at a point exactly corresponding to the center of the bore of the tube. The middle section of the arch is now removed, and one of the delicate pins soldered to it at the point indicated by the notch previously made.

The pin must be soldered on a line parallel with the bore of the tube. To accomplish this the head of the pin is held with the pin-holder (Fig. 16) and the fishtail end of the pin is brought in contact with the notch in the arch, and a very minute piece of 14-karat or 18-karat gold solder, with flux, is used to effect the union. A very delicate flame only must be used, else either the pin or the arch will be injured.

Another excellent method for soldering the pin at the desired point, suggested by Dr. Ketcham, is to fuse slightly a very minute piece of solder to the middle section of the arch over the notch. The middle section is then again placed in position, and another notch made in the fused solder at the same point as the first notch, after which the middle section is removed, and the end of the pin engaged with the arch at the notch, and the solder re-fused.

Whichever plan is employed, the greatest care must be observed to solder the pin at exactly the point indicated, and with the proper alignment.

The nut on the screw section is now turned forward, and this section passed into the tube of the anchor band until there is no connection between it and the middle section. The pin is then placed in the tube, and the bending of the arch continued until the next tube is reached, when the middle section of the arch is again marked and notched, exactly in the center of the bore of the second tube, and the second pin is attached, as before.

The two pins are then inserted in the tubes and the careful bending of the middle section and the attachment of the pins continued until all the pins are in place and the middle section of the arch rests *passively* in position upon the teeth, with the pins in the tubes and the hook end of each pin engaging the beveled gingival end of its tube.

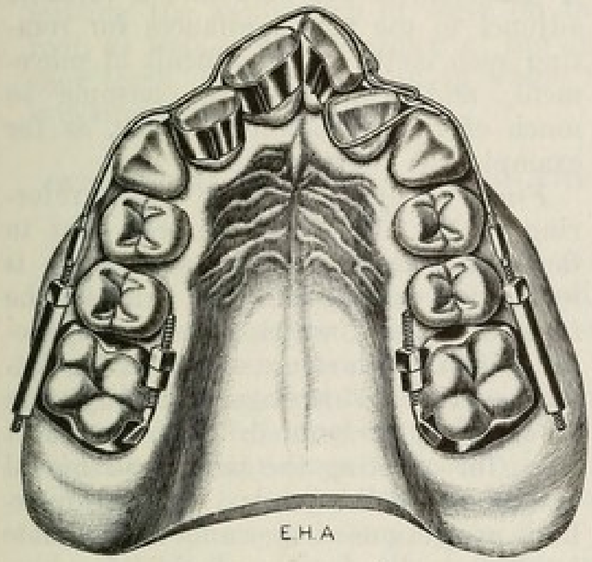
Both screw sections are now slipped forward and engaged with the squared ends of the middle section to the full depth of the sockets. The nuts on the screw sections are tightened to the full depth of the extension flange with the friction sleeve, but no force is exerted upon the teeth in any part of the device. The patient is then dismissed.

The appliance is allowed to remain in the mouth for a week or so, until it has perfectly adapted itself to the teeth, and all possible soreness has subsided. At the next visit of the patient, the nuts on the screw sections are turned forward until the screw and middle sections are disjointed; the hook ends of the pins are dislodged, the middle section removed, and the appliance and teeth cleansed. The arch is then *very slightly* straightened at each bend, the pins are given a slight spring forward if it is desired to exert pressure labially on the apices of the roots of the teeth, the middle section is again gently sprung into position upon the teeth, and the hook ends of the pins relocked. The screw sections and nuts are readjusted so that there is gentle force, and the patient dismissed for at least two or three weeks. In like manner, at each visit of the patient, the middle section is removed and very slightly straightened still further, until finally it has the ideal arch form, and the crowns and roots of the teeth have been carried to their normal positions.

It will be seen that by this method a most gentle force is made to constantly operate not only on the crowns of the teeth, but throughout the entire length of their roots.

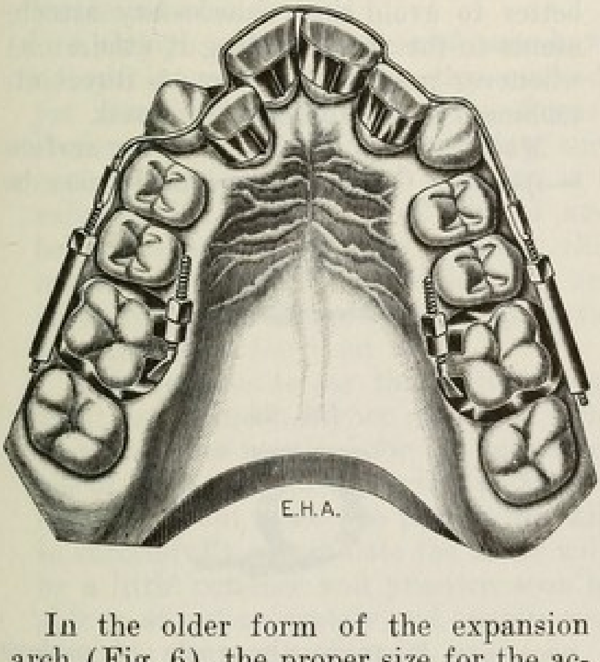
Where the teeth are crowded and overlapped, as in the case under consideration, it must be remembered that the bends in the middle section should correspond to the overlapping of the teeth, or to the diminution in the size of the dental arch. Hence it is very important that the crimps in the middle section of the arch be sufficient so that as the arch is straightened the teeth will not bind or crowd and thus interfere with their movement. This is also necessary to avoid the annoyance of removal and reattachment of the pins, which should rarely, if ever, be necessary, if judgment and skill are used in the original bending. However, in effecting double rotation of the central incisors (Figs. 17 and 18), should spaces begin to appear between these teeth, it will be necessary to gradually shorten the middle section. This is accomplished by slightly crimping the

Fig. 17.



middle section opposite each of these spaces at each visit of the patient, thereby maintaining the proper length of the middle section.

Fig. 18.

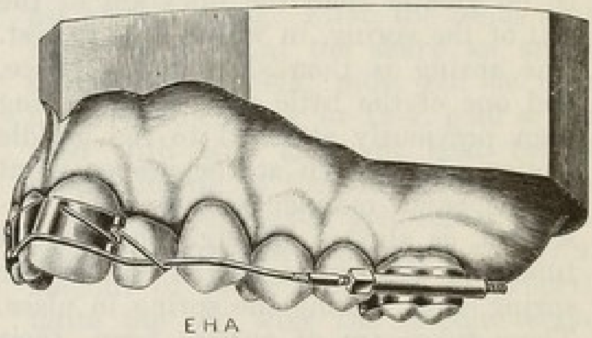


In the older form of the expansion arch (Fig. 6), the proper size for the accommodation of the enlarging dental arch was gained wholly by means of the nuts; with the new method, both the nuts and the straightening of the middle section provide for the necessary enlargement of the dental arch. The extent to which one or the other of these two means of enlargement is used depends on the requirements of the case treated. In some cases the enlargement is made almost exclusively through the nuts and screw sections, in others chiefly by straightening the bends in the middle section. Both means afford the most perfect control of the size of the appliance. The screw sectional adjustment, like the finer screw adjustment of a microscope, will always be most valuable.

The lock hook. It will be seen in Figs. 13 and 14 that a delicate hook is attached

Fig. 19.

Fig. 20.



to the bands on the premolars, engaging the arch. The end of this hook is bent sidewise sharply at right angles, and sprung slightly over the arch. This additional attachment to the ordinary form of hook forms a simple but effective lock to prevent the accidental unhooking and displacement of the arch. It has elasticity, and must be gently sprung to one side when it is desired to remove the arch. While very simple, efficient, and easier to employ than the tube-and-pin form of attachment, it should be used only when *tipping* of the crown is desired.

The hook is of the same material—precious metal—and same diameter as the pins. It must always be delicate in size and carefully proportioned, the hook-like projection to be never more than three-thirty-seconds of an inch in length.

Greater length means unnecessary bulk, and renders the appliance liable to injury during mastication.

Coiled spring attachment. The delicate coiled spring is a novel attachment to the arch. In connection with the pin, tube, and middle section, it will in the hands of those who study its possibilities and master its adjustment be found very useful for rotating teeth or for other tooth movements. It is shown separately in Fig. 19, and in position on the teeth in Fig. 20. Here it is used as an auxiliary to the arch in the rotation of a central incisor, the center or coil of the spring being engaged by a pin. To adjust it, the tube is soldered to the band, and the middle third of the tube cut entirely away, leaving the two end sections attached to the band. The space between the two ends of the tube should be no greater than the thickness of the coil of the spring, in which it is to rest. The spring is then slipped into place, and one of the little pins, after having been previously attached to the middle section of the arch at the proper point in the same manner as previously described, is slipped through the divided tube and the center of the coil of the spring, thus locking the spring in place. These tubes are of special form, their walls being thickened at the point of attachment to the band material. This is necessary to permit the pin to pass through the coil of the spring, the diameter of the wire of which the latter is made being greater than that of the walls of the other small tubes, Fig. 15. One end of the spring must bear against the middle section of the arch, and should be bent into the form of a hook to prevent its displacement. The other or free end of the spring must bear against the tooth to be rotated or against the band surrounding it in such a way as to give tension in the desired direction. In the particular case illustrated in Figs. 17 and 20, the free end of the spring bears upon the mesio-labial angle of the tooth.

The force from the coiled spring is not great, but ample to stimulate cellular activity, and its range is sufficient to maintain constant pressure for many weeks, if it be skilfully adjusted. It should occasionally be removed, and the tension renewed by its proper bending.

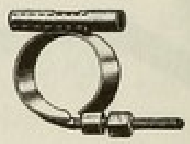
Patience is necessary in order to develop skill in the use of this spring, but, if mastered, it will be found a valuable adjunct to the new appliances for rotating such teeth as are difficult of movement, and which always consume so much of the orthodontist's time, as for example the lower canines.

Finger projections. By again referring to Fig. 17 it will be seen that to the middle section of the arch there is soldered a section of wire bent in the form of a hook, which engages the mesial and labial surfaces of one of the lateral incisors. This finger-like projection is occasionally bent in order to exert force for effecting the labial and mesial movements of this tooth. Similar finger-like projections will, under favorable conditions, be found valuable for performing other tooth movements. It may also be provided with pin-and-tube connections for attachment to the tooth which it is designed to move, but as simplicity is of such very great importance in orthodontic appliances, it is always better to avoid any unnecessary attachments to the arch, bending it (the arch) whenever possible, to effect its direct attachment to the tooth to be moved.

Molar clamp band and screw section—special. On rare occasions it may be

Fig. 21.

Fig. 22.



necessary to move the roots of molars buccally or lingually, and this may be accomplished by the special form of non-turnable screw section with the special sheath on the anchor clamp band shown in Figs. 21 and 22. The screw section is flattened on one side, and engages a similarly flattened portion of the inner wall of the sheath of the anchor band, thus effectually preventing the screw from turning within the sheath, and permitting the application of force on the root, as well as on the crown of the anchor tooth, in the direction in which it is desired to move it.

INDICATIONS FOR, AND SCOPE OF THE NEW APPLIANCE.

It is not expected or intended that this method or these appliances will wholly displace the expansion arch as it is now so almost universally used, but it is a method of treatment which the intelligent, skilful orthodontist will find very valuable in many cases. Probably it will be found to be of greatest value in the treatment of cases belonging to class I where there is arrest in the development of the bone, although the writer sees no reason why its use may not be extended to include the treatment of cases belonging to other classes, their divisions and subdivisions; indeed, he can see many possible advantages in its use in the treatment of such cases.

Although a large number of cases have not yet been corrected by this method, yet many are being treated by former students of the writer with sufficient success to convince him that the plan is a valuable one, and he fondly hopes and believes that those who master this method will share his conviction that another real step forward in the progress of orthodontia has been made.

It is needless to say that better judgment and a much higher degree of technical skill are required for the successful use of these than for the writer's standard appliances, but those who possess the skill to successfully manipulate the latter will, by a little patience and practice, soon be able to adjust accurately and operate successfully the new appliances.

CAUTIONARY MEASURES IN MANIPULATION.

The success of this method, moreover, depends largely upon the metal of which the middle sections of the arches and the pins are composed. As the teeth are moved by means of the force derived from the spring of the arch, it is necessary that it possess a high degree of elasticity, and that this elasticity be not reduced by the heat necessary in soldering the pins directly to the arch. The metal must also be as tough as possible to permit of the middle sections of the arch being freely crimped and afterward gradually straightened without breaking, as the teeth move into their correct positions.

These exactions gave the metallurgist a difficult problem to solve, but after many months of patient research and experiment the result achieved in the combination of precious metals is believed to closely approximate the ideal for the purpose of these appliances. Still, the orthodontist must observe caution in the use of this metal. First, the bends must never be made at too sharp an angle; secondly, the metal must not be overheated; either 14-k. or 18-k. gold solder, used with only sufficient heat for its proper fusing, is the best solder for the purpose, though 22-k. gold solder may be used, if great care is exercised. Only an amount of solder sufficient to properly unite the pin with the middle section should be used. Great care must be exercised not to fuse the solder into the wire by overheating, as inelasticity and brittleness will result.

If the metal is heated to dull redness and immediately plunged in water its elasticity is reduced, but if allowed to cool slowly in the air, after heating, its full elasticity is preserved.

The Grünberg blowpipe, with its most delicate flame, is best suited for this soldering.

ADVANTAGES OF THE NEW APPLIANCE.

It may at first appear to some that this method of treatment in some cases requires a longer time to bring the teeth into the desired positions than to only tip the crowns, as is now the custom. Since, however, no case can be declared completed until the requisite amount of bone development has been gained through mechanical retention to permanently maintain the teeth in their corrected positions, it will be found that the new method actually requires less time. That

Fig. 23.

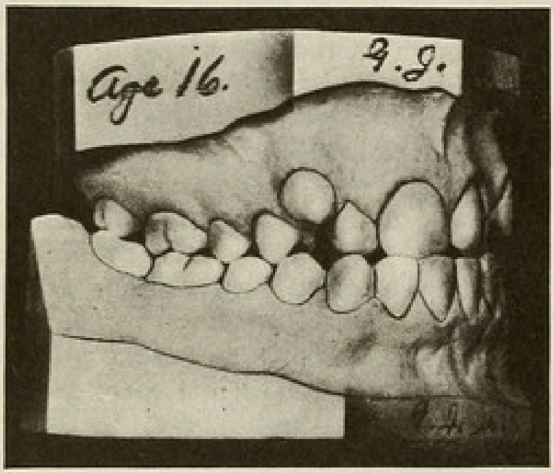
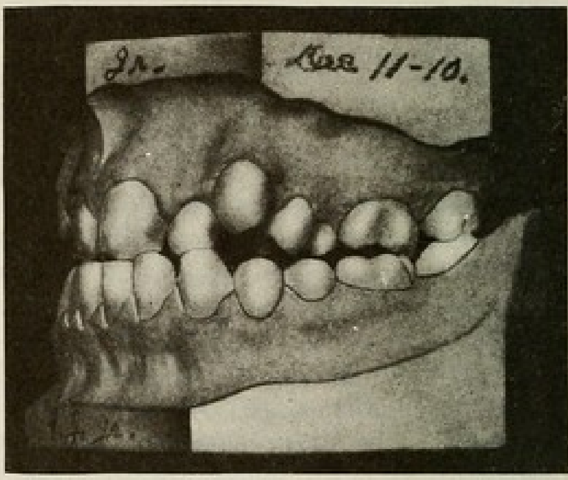
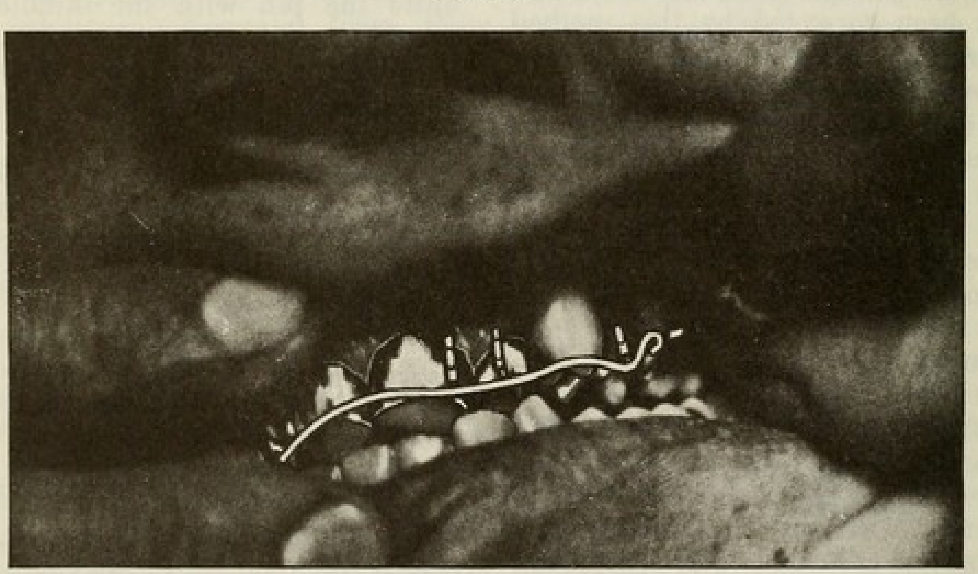


Fig. 24.



is to say, from the time the appliance is first adjusted until the bone is normally developed and normal occlusion permanently established by the new method will cover a shorter period than is consumed

Fig. 25.



in accomplishing the same result by the present method.

Pain in tooth movement is practically abolished by this method, and what is probably the ideal in nature's plan of tooth movement is most nearly attained. Decidedly more perfect control over the distribution of force is gained, so that the loss of time through accidental disturbance of the ligatures or other and cruder means of attachment is done away with. The danger of displacement of the appliance is practically eliminated, so that a patient may, if unavoidable, miss his appointments almost indefinitely without injury to, or undesirable movement of his teeth. The time of both patient and orthodontist is also greatly conserved, as frequent appointments are unnecessary, and patients who live at great distances from their orthodontists may be treated far more conveniently than heretofore.

The entire appliance having been reduced to the smallest bulk, conspicuousness and inconvenience to the patient from its wearing are reduced to the minimum, as is also the danger of displacing the appliance, so the patient may be instructed to be unusually thorough in the cleansing of his teeth. The parts of this appliance are so delicate, graceful, and perfectly made that if they are correctly adjusted upon the teeth, they present an appearance not unpleasing—a feature that is much appreciated by the critical and sensitive wearer; on the other hand, it is remarkable how greatly the artistic effect may be marred by carelessness with

FIG. 26.

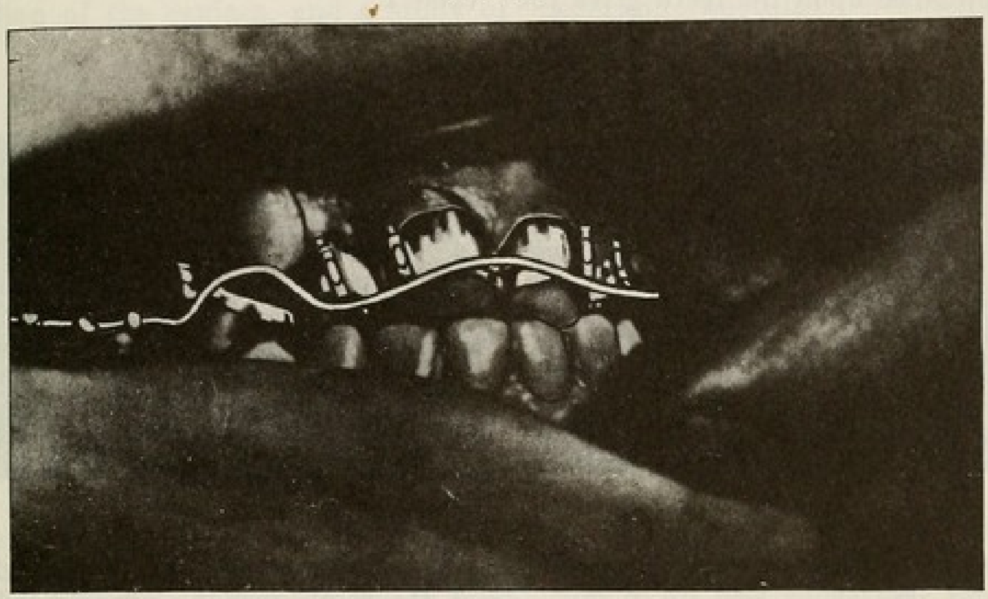
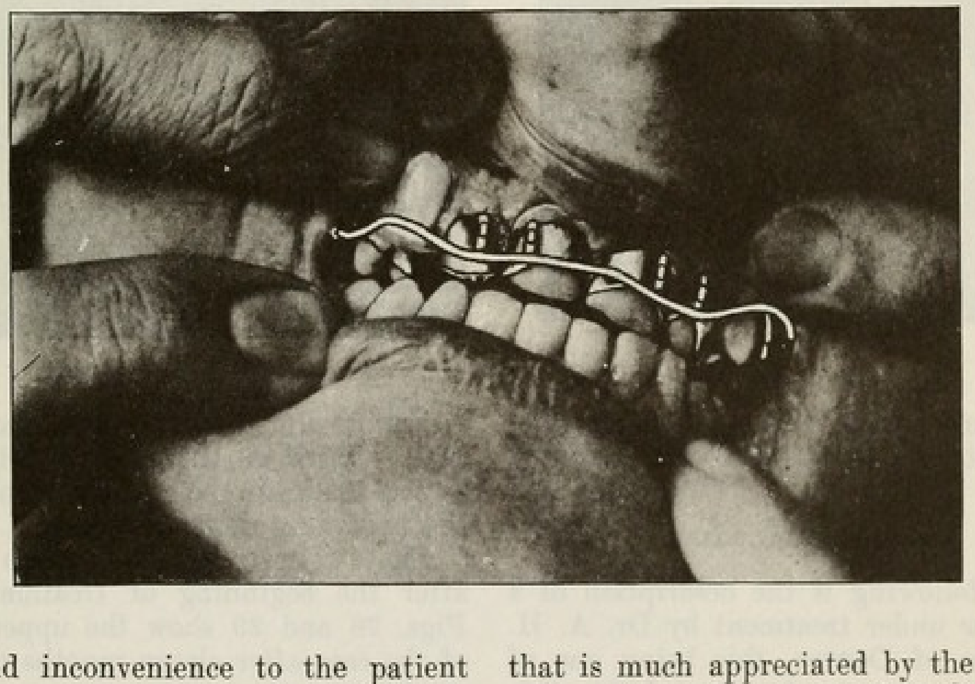


FIG. 27.



regard to size, proportion, and relationship of the parts. I think it was Millet who said, "Art is things in their places," and the adjustment of these or of any other appliance upon the teeth gives the orthodontist full opportunity for the expression of art.

Finally, no other method of treatment offers such great possibilities in tissue development and in the ultimate establishment of artistic facial balance.

A PRACTICAL CASE.

The following is the description of a case now under treatment by Dr. A. H. Ketcham of Denver, this being one of the first cases to be treated by this method, and although it is not entirely completed, the excellent results from eleven months' wearing of the appliances are clearly demonstrated.

The case is that of a boy, age sixteen years, a typical case belonging to class I.

FIG. 28.

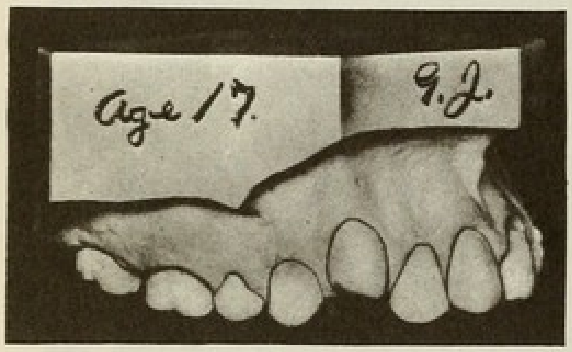
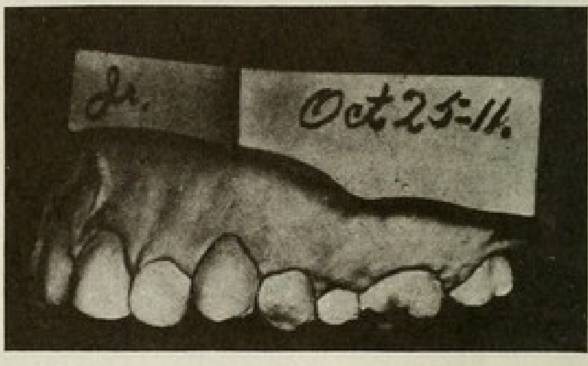


FIG. 29.



Figs. 23 and 24 show the malocclusion of the teeth and the pronounced arrest in the development of the bone at the time treatment was begun.

FIG. 30.

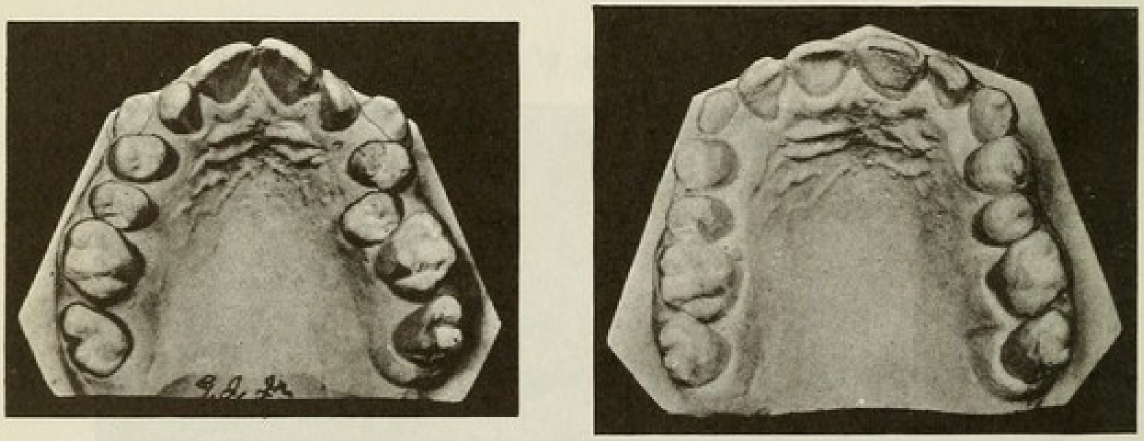


Fig. 25 illustrates the appliances originally placed on the natural teeth.

Fig. 26 shows the case one month after the beginning of treatment.

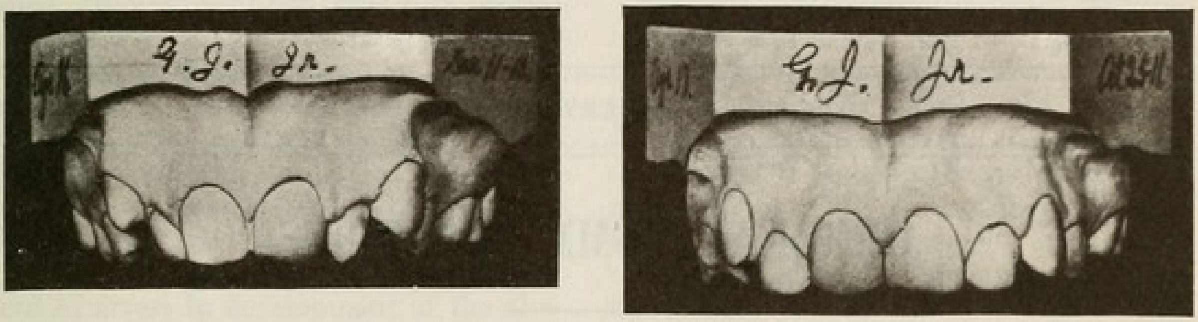
Fig. 27 illustrates the case ten months after the beginning of treatment, and Figs. 28 and 29 show the upper model of the case after eleven months of treatment.

Fig. 30 shows the case from the occlusal aspect at the time of beginning treatment and eleven months later (December 1911), and Fig. 31 shows the same models from the labial aspect.

Ample space has been gained for the eruption of the canines, and a study of these pictures will reveal that the roots of the upper anterior teeth have been shifted to a very noticeable degree, and that the bone has developed to nearly its normal contour. Probably two or three months more of treatment will be sufficient for the completion of this case, no retention being necessary.

The results of tooth movement and bone development in this history-making case, after only eleven months of treatment, have been truly remarkable, and are sufficient, we think, to awaken surprise and great enthusiasm in the mind of the thoughtful orthodontist, and to stimulate him to his best endeavors; for it is difficult to predict what possibilities of more rapid and satisfactory results may be in store for him who will familiarize himself with this plan of treatment and will master its technique.

Fig. 31.



THE

DENTAL COSMOS.

VOL. LV. JANUARY 1913. No. 1.

ORIGINAL COMMUNICATIONS.

FURTHER STEPS IN THE PROGRESS OF ORTHODONTIA.

By EDWARD H. ANGLE, M.D., D.D.S., New London, Conn.

(Read before the Alumni Society of the Angle School of Orthodontia, at its seventh annual meeting, September 5, 1912.)

MR. PRESIDENT AND MEMBERS OF THE ALUMNI SOCIETY:

AT our meeting one year ago, as you will recall, I presented a new plan of treatment of malocclusion of the teeth, with new forms of appliances for accomplishing the various tooth movements in accordance with this plan, a description of which was published in the DENTAL COSMOS for August last. A close study of that description is necessary for a full comprehension of what I shall present today.

As a result of wider observation, much thought, and careful experimenting, I think I can today not only greatly simplify the technique in the adjustment and operation of the appliances then presented, but lead you to a more intelligent appreciation of the possibilities and advantages to be gained by the employment of the new method of treatment.

NECESSITY OF EXACT DIAGNOSIS.

All of you here today are fully aware of the importance of a thorough knowledge of the normal occlusion of the teeth and normal facial balance as a guide to the intelligent direction of your efforts in the correction of malocclusion. Also you are aware of the importance of the full complement of teeth, and the very important part that each tooth plays in its relation to all the other teeth of the denture, that the denture may not only be in function most efficient, but that it may contribute its full part to the normal beauty and balance of the face according to the individual type, and also its normal part in the possibility of normal growth and development of the throat and nose, all of which are so essential to the health and growth of the individual.

For a number of years we have been able to classify malocclusion, to note quite accurately the degree of variation of position from the normal of the crown of each tooth, and to judge of its necessary movement in establishing normal occlusion. But heretofore the crowns of the teeth have received our chief attention, both in diagnosis and in tooth movement, and we have been largely dependent upon nature for the movement of the roots, the positions they will finally occupy being largely problematical—due chiefly to the limitations of the orthodontic appliances heretofore at our disposal. But a new era is before us, with far greater possibilities, but with these possibilities come, also, greater responsibilities as to diagnosis, knowledge of the tissues we operate upon, and technique. We must now study our cases so carefully in the beginning as to enable us to determine accurately not only how great are the variations of position from the normal of the crowns of the teeth, but the extent of the apical displacement and incorrect angle of inclination of each root, and also the extent of arrest in development of the alveolar process and co-related bone, that we may have a clear conception of the exact direction and extent each tooth should be moved and the amount of bone development necessary in order that nature may build the denture to full completion in accordance with the architectural design of the individual type.

STUDY OF BONE-GROWTH A PREREQUISITE TO SUCCESSFUL REGULATION.

Science discountenances guessing and exacts accuracy, and I believe it is now quite possible to fulfil the demands of science in orthodontic procedure; but this necessitates, as we have said, closer study and a more intimate knowledge of the habits of bone-growth and of the tissues we are to operate upon, for let us ever remember that we can do nothing of permanent value by ourselves in our efforts at treatment, but only as we work in conjunction with nature, studying her carefully, interpreting her wishes, and intelligently assisting her in her efforts of growth and development of the denture to be in harmony with the line of occlusion and the forces which govern occlusion.

Fortunate are we at this time in having access to those splendid chapters on bone life contained in Dr. Noyes' recently published book, and to the wonderful researches in bone-growth by another of our own number, Dr. Oppenheim of Vienna, together with the epoch-marking researches on the development and growth of bone by Dr. McEwen of the University of Glasgow, just issued, all of which will later be reviewed at this meeting.

DELICACY OF THE NEW APPLIANCES.

Having determined the exact requirements of crown and root movement, and the bone development necessary, our appliances should be such as will best fulfil these demands, namely, to exert pressure upon the teeth in the right direction and with only the proper force to normally stimulate the various bone cells in their work of absorption and rebuilding the bone. As we now know that this pressure should be very gentle, our appliances may be very delicate—far more delicate than we formerly believed practicable, and the new appliances have been designed with a view to fulfilling as nearly as possible these natural requirements.

In order to refresh your memories regarding the new appliances let me briefly review the description of the more important of them, together with that of their adjustment and manner of operation.

THE EXPANSION ARCH IN ITS PRESENT PERFECTION.

The ideal principle in an orthodontic appliance, that of the expansion arch, is still employed, but the arch now used is of necessity of much greater delicacy than the one formerly employed, and it is also further modified for greater convenience in use. It is divided into three sections, a middle and two end sections. The middle section is very elastic, is smooth, round, and very delicate in size, being only .030″ in diameter. It has squared ends which accurately fit into square holes in the ends of the threaded end sections, Fig. 1. In operation the end sections are slipped into the sheaths of the anchor bands on the teeth used as anchorage. The middle section is carefully bent so that it will lie passively in close relation with the buccal and labial surfaces of the teeth in their malpositions, with its ends telescoping with the threaded end sections for about one-eighth of an inch.

Instead of being attached to the teeth to be moved as heretofore by means of wire ligatures, bands, and spurs, the attachment of the arch is now made more direct and positive by means of delicate pins soldered to it, which engage delicate tubes soldered to bands on the teeth to be moved. The pins and tubes are shown in Fig. 2, and the whole appliance, Fig. 3, is shown on the upper dental arch of an ordinary case belonging to class I, which requires much bodily movement of the incisors, with a large amount of bone development.

Fig. 1.

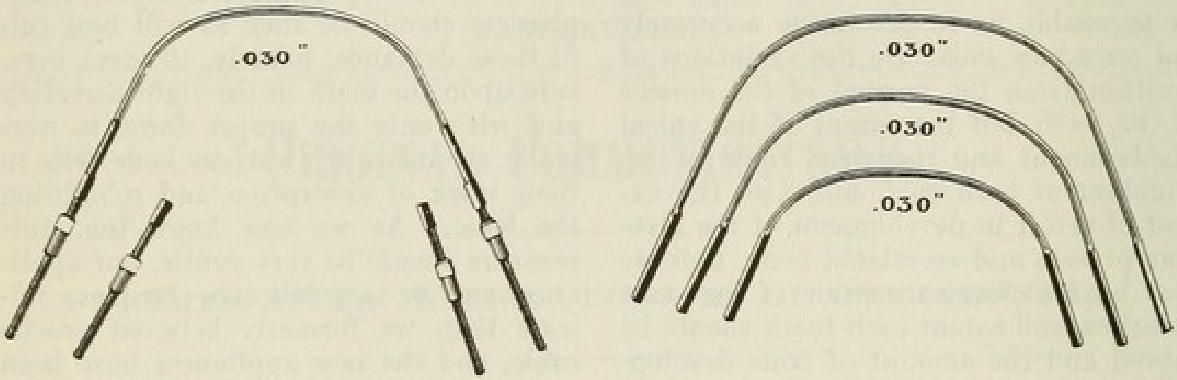
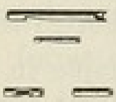


Fig. 2.

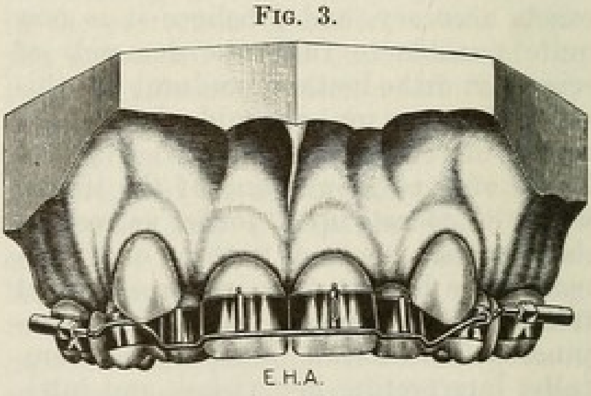


Force is exerted on the teeth to be moved by the elasticity of the middle section of the arch and the pins, the middle section being occasionally removed from the teeth and one or more of the bends in it slightly straightened, after which it is again sprung into position on the teeth, and this is repeated at intervals until both crowns and roots of the teeth have been carried into their normal positions in the line of occlusion. It will thus be seen that the force derived from the elasticity of the arch and pins is so distributed to the teeth that the latter will be carried bodily, apices of roots as well as crowns, in the direction in which force is exerted.

PREDETERMINING ROOT MOVEMENT BY AN IMPROVED TECHNIQUE.

And here I wish to improve upon some of the technique that I gave you one year ago. I then said that the pins were occasionally to be bent forward or laterally to accelerate or change the direction of movement of the apices of the roots of the teeth, thus resorting to a considerable amount of guessing as to the amount and direction of the force. I now believe we should have clearly fixed in our minds, before the adjustment of the appliances, the exact direction and extent that the apex of each root should be moved, and that we should so place our pins in the beginning, giving them the requisite inclination for the proper root movement, as to avoid the necessity for their subsequent bending, the only subsequent

Fig. 3.



change in the mechanism then required being the straightening of the bends in the middle section of the arch and the proper adjustment of the end sections through the manipulation of the nuts. Only by this means can we avoid unnecessary disturbance of the tissues, with the resultant inflammation and injury. To make this clear, if it has been previously determined that the apices of the roots of one or both of the lateral incisors require more movement labially than those of the centrals, the pins should be given the necessary additional inclination when they are soldered to the arch. In like manner, other additional root movements should be anticipated, and the pins be placed for their accomplishment, thus reducing to the minimum the necessity for subsequent changes.

FIG. 4.

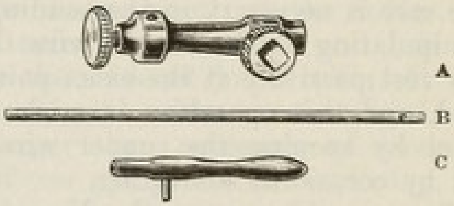
POSITION OF PINS AND TUBES.

In order that the force may best be exerted on the roots of the teeth, the pins and tubes should be made to line parallel with the axes of the teeth whenever possible, and at the same time they should be parallel with each other, in order to permit the telescoping of the pins with the tubes. But as the teeth are often found in such irregular positions, the first impression in such cases would probably be that if the tubes were placed parallel with the axes of the teeth, the tubes themselves would diverge so greatly from the parallel as to make the insertion of the pins impossible. But if you will study your models carefully, accurately noting the direction of the line of axis of each tooth, you will doubtless be surprised, as I have been, to find that when the tubes have been placed so that they align with the axes of the teeth, they will be parallel in nearly all cases, or sufficiently so as easily to permit, with gentleness and care, the telescoping of the pins with them, the slight divergence from the parallel being accommodated by the spring of pin and arch. In some instances, however, the irregularity of position of a tooth may be so great as to necessitate slightly varying the inclination of the tube from the parallel in its placing.

DEVICE FOR SOLDERING PINS TO ARCH WITH PERFECT ACCURACY.

According to the technique for placing the pin which I gave you one year ago, the pin was to be held while being soldered by means of a pin-holder (Fig. 4) in one hand, while the arch was supported by the other hand, thus relying on the skill and judgment of the operator for the inclination of the pin, and, while many of you are sufficiently skilful to place it with a considerable degree of accuracy by this method, yet the possibilities of inaccuracy are great, often requiring the re-soldering of the pin at a different angle, and its frequent final

FIG. 5.



bending to give it the proper alignment, which often results in breaking it or weakening it at the point of its attachment. The importance of the accuracy of this operation I have already dwelt upon, and if you will observe care in the method I shall now give you, you may entirely eliminate inaccuracy in the operation.

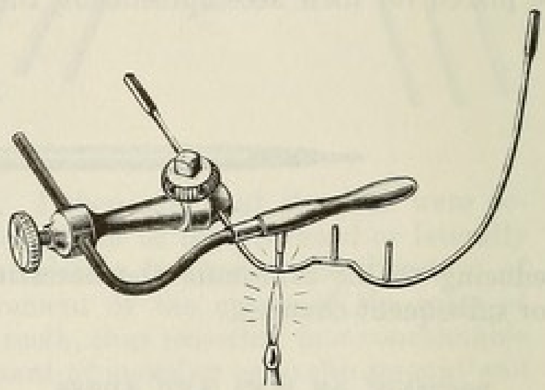
For supporting the pin in the proper

alignment while it is being soldered to the arch I have devised a peculiar form of soldering jig, shown in Fig. 5. It consists of a delicate vise, A, a section of soft copper wire, B, and a pin-carrier, C. In use the jaws of the vise are firmly clamped on the middle section of the arch at a point not more than half an inch from where the pin is to be soldered, the arch lying passively in contact with the buccal and labial surfaces of the teeth, and the opposite end of the vise projecting outward between the lips of the patient, for in practice the appliances should always be fitted directly to the natural teeth, never to plaster models. The round end of the copper wire telescopes a round hole near the outer end of the vise and is firmly clamped in position by a thumb-screw. The copper wire is then bent around so that its other end, slightly flattened on one side, is made to rest passively at the exact point that the head of the pin is to occupy after it is soldered to the arch. Usually this point is at the gingival end of the orifice of the tube on the tooth to be moved. If, however, it is desired to move the apex of the root of a tooth more than its crown in a certain direction, the pin must be given the necessary angle of inclination to accomplish this movement. The flattened end of the copper wire is therefore made to rest exactly at the point necessary to give this inclination, independent of the position of the mouth of the tube. Considerable care is necessary in the bending and manipulating of the copper wire that it may rest passively at the exact point desired, and this operation is made much easier by keeping the copper wire very soft by occasional annealing.

The wire is now gently disconnected from the vise without changing its form, and laid aside. The middle section of the arch is also carefully disconnected from the end section, and it and the vise are removed from the mouth without changing the form of the arch or its relation with the vise.

The round end of the copper wire is now replaced in its original position in the vise and reclamped, and the pin-carrier slipped over the flattened end of the copper wire to the full depth of the hole in its end. Then the pin is placed in the hole in the pin-carrier, with its hook pointing lingually, and the pin-carrier is turned to bring the chisel crescent end of the pin in a similarly formed delicate notch in the middle arch section, its position having been previously carefully determined and the notch carefully made at a point directly opposite the orifice of the tube on the band against which the middle section of the arch is to rest and into which the pin is to fit. By this means the pin is accurately aligned and supported and

FIG. 6.



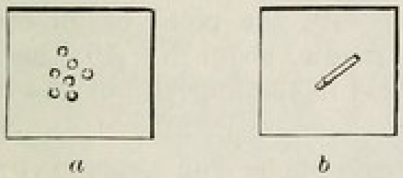
ready to be soldered in position, as shown in Fig. 6.

I am indebted to Drs. Gough and Lane for suggestions relative to the soldering jig—to Dr. Gough for suggesting the detached pin-carrier, and to Dr. Lane for the suggestion of the thumb-screw in the end of the vise for clamping the segment of copper wire in position.

CONVENIENT FORM OF SOLDER TO INSURE ACCURACY IN SOLDERING PINS TO ARCH.

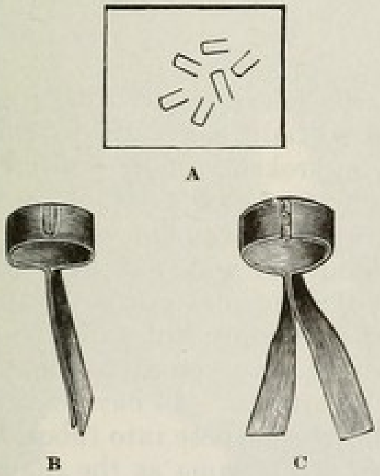
Another point on which I wish to improve the suggested technique of one year ago is in the form of the solder to be used for making these attachments. I then said we should guess at the amount of solder, cutting it in the usual small squares, and either previously partially fusing it upon the middle section of the arch, or hoping it would remain in contact with pin and arch while being fused. The result, following this time-honored custom of soldering, was that too often the fragment of solder became displaced, or was found imperfectly distributed after it was fused, or that too little or too much had been used. All of these difficulties are now overcome by having

Fig. 7.



the bits of solder of proper size and shape. This I have accomplished by first drawing the solder into very delicate wire and then forming it into minute rings, *a*, Fig. 7, the inner diameter of which is the same as the diameter of the pin over which one little ring is slipped before putting the pin in the carrier, as shown in *b*, Fig. 7. The sample rings which I shall

Fig. 8.

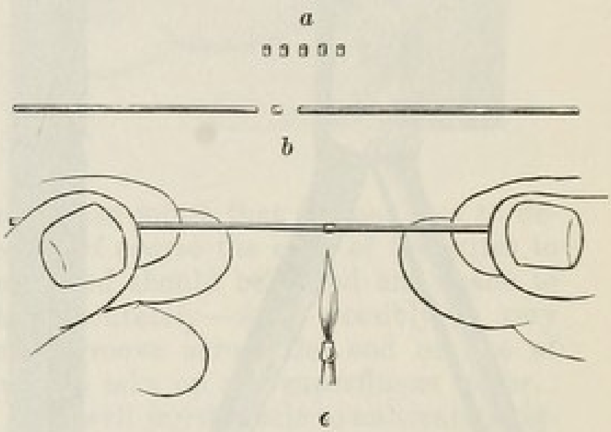


A, Staple form of solder. B, Staple of solder on band. C, Tube, solder, staple, and band.

pass around I believe will be found to contain just the proper amount of solder and of the correct karat, which result has been attained after considerable experimentation.

In fusing the solder it is held in contact with the delicate flame, the point of the flame striking the arch directly underneath the pin, as shown in Fig. 6, and I wish to impress upon you the importance of observing care in this operation. First, the notch in the arch must be delicate and of the proper shape to best engage the thin, crescent-shaped end of the pin. Just the requisite amount of flux should be used, and the ring of solder must not only encircle the end of the pin, but lie in actual contact with the arch, otherwise there will be no union be-

Fig. 9.



tween pin and arch. The flame must be very delicate. That from the Grünberg blowpipe is the best, and the heat must be applied slowly and very evenly so that the pin and arch will be equally heated, and the temperature very gradually raised to just the fusing-point of the solder. You will note how beautiful and how strong are the soldered joints (Fig. 6), and how evenly the solder has flowed. If a flame larger than necessary be used, as many of you will persist in employing, there is almost a certainty of injuring, if not of ruining, either the pin or the arch, or both.

STAPLE-SHAPED PIECES OF SOLDER FOR SOLDERING TUBES TO BANDS.

Taking advantage of this principle of soldering, I have applied it also to the attachment of the tubes to the bands, in which case the pieces of solder are made in the form of minute staples (A, Fig. 8).

one of which is picked up with a very delicate camel's-hair brush, previously dipped in liquid flux, and carried to the desired position on the band, B, Fig. 8. The tube is then placed in position between the projections of the staple, C, Fig. 8, and carried to the flame, which should be even more delicate than the

Fig. 10.

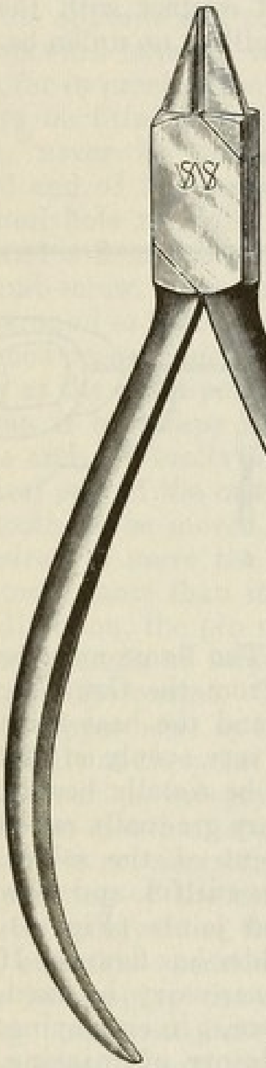
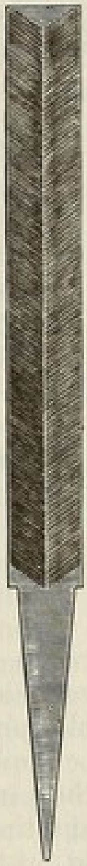


Fig. 11.



one used in soldering the pin, because there is less metal to be heated, and the temperature very slowly and evenly raised to the fusing-point of the solder. If good flux be used and the temperature be raised very slowly and be very evenly distributed, so that the tube and band and solder are equally heated, the most even and perfect distribution of the solder, without the least displacement of the tube, will result. On the other hand, if a large flame be used, the band and tube will be heated unequally and the solder fused on one side before it is on the other, which will always displace the tube to the side on which fusion first takes place. If, however, the tube is slightly displaced while the solder is melting, it may, before removal from the flame, be best teased back to its correct position with the point of an ordinary sewing needle, about No. 10, the needle being held in the fingers, not in a broach.

TUBES OF SOLDER FOR SOLDERING ACCURATE BUTT JOINTS.

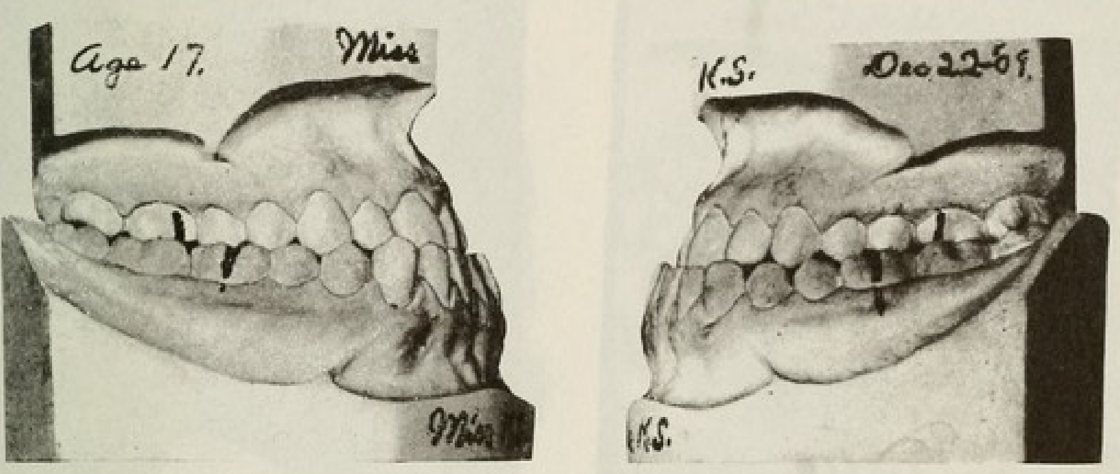
And here is still another extension in the use of this novel method of soldering,

Fig. 12.

Fig. 13.

with which I believe you will be pleased: It is occasionally necessary to unite, end to end, a broken middle section of the arch, or to lengthen a middle section by adding to it a segment of wire of the same diameter, and you all know how difficult it is to make an accurate, even, soldered butt joint, but with the method I shall now give you it becomes a very simple operation. I have drawn the solder for the purpose into tubes, the bore of which is the same as the diameter of the middle sections of the arch, *i.e.* .030". The wall of the tubes is very thin. This solder tubing is cut in short segments (*a*, Fig. 9). Flux is placed on the ends of the wires to be united and one of the little ferrules of solder is slipped for half its length over one of these ends (*b*, Fig. 9). The end of the other wire is then inserted in the other end of the ferrule (*c*, Fig. 9), and all carried to the flame, with the little ferrule making a sure and accurate support for the ends of the wires. The temperature is then slowly raised to

FIG. 14.



the melting-point of the solder by applying heat, not directly to the solder, but to the wire on each side, alternating from

FIG. 15.

one side to the other. The little ferrules of solder insure not only the accurate apposition of the ends of the wires, but the proper quantity and distribution of the solder for making a very strong and perfect joint. And if you will use thought and cultivate skill in this operation, you may make joints that are not easy to detect. Of course the ends of the wires to be united should be round and made to abut accurately—with, possibly, a very small groove across the end of one of them to take up any superfluous solder.

It is well worth while to cultivate judgment and skill in all our technique, and we all can easily do this. It will result not only in the saving of much time, but in real satisfaction in our work.

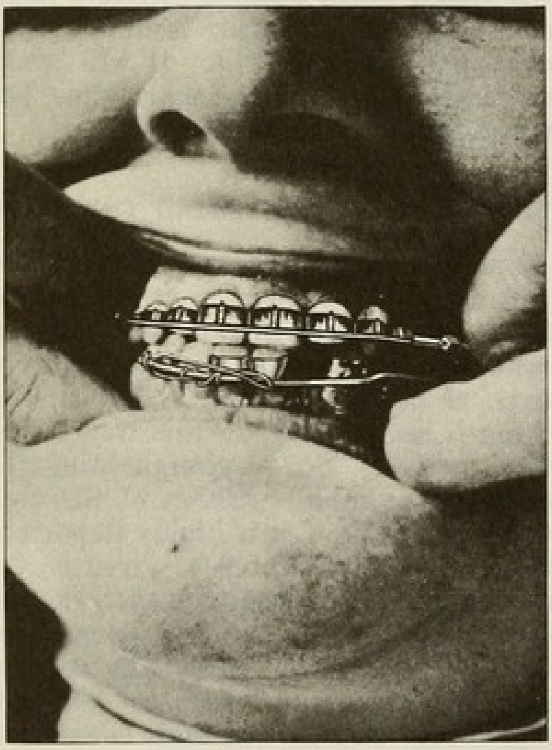
CAUTION IN STRAIGHTENING THE ARCH.

Now a word of caution. It should be remembered that there is practically no loss of energy with this method of treatment by slipping or displacement of parts, as compared with the probability of much loss of force in this way in the older method. So, in straightening the bends in the middle section of the arch from time to time, it is highly important that not too much force be given to the moving teeth, and that the orthodontist shall know quite accurately its amount and direction. Dr. Young, who has had much experience in the use of the new appliances, assures me that he is now convinced that rarely more than one, or at most two of the bends should be slightly straightened at any one appointment of the patient, leaving the balance of the arch as it is for control of the force, and that the amount of straightening

Fig. 16.

should never be more at any one time than would change the relation of the

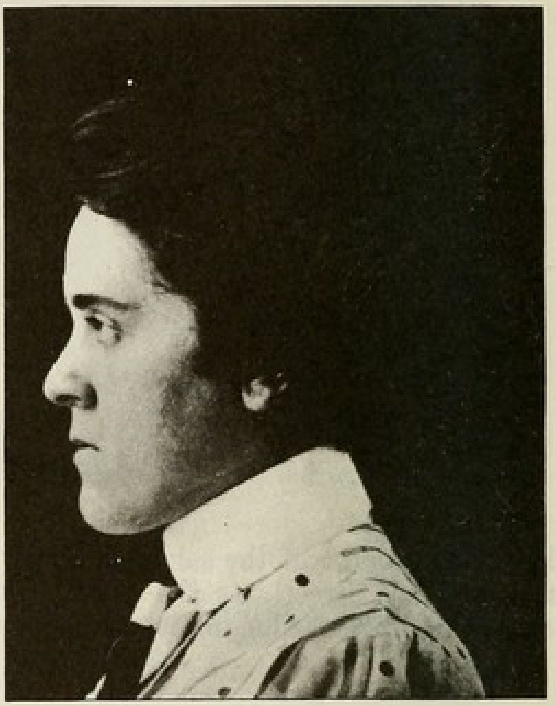
Fig. 18.



pin with the tube the thickness of the wall of the tube.

It is also important that the square ends of the middle section of the arch

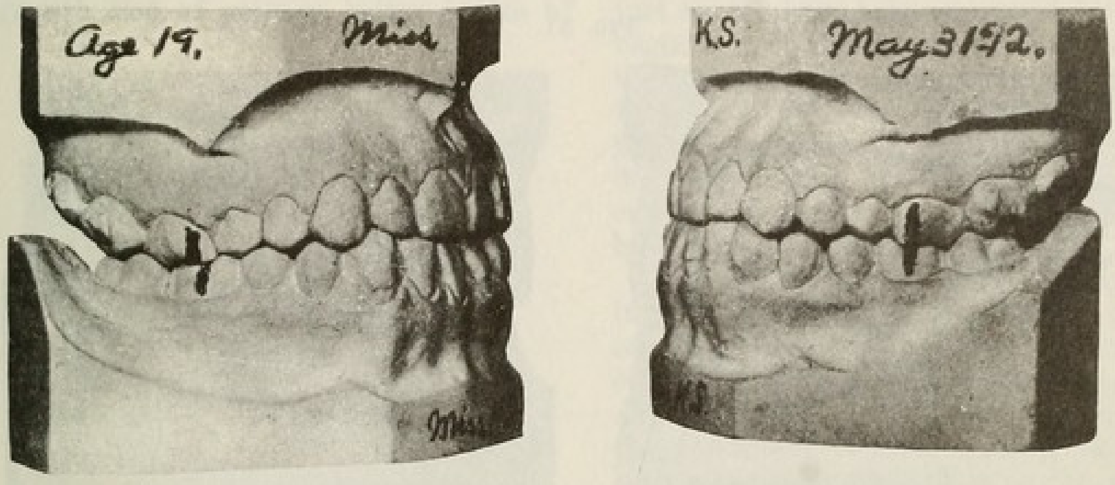
Fig. 17.



shall be kept in proper relations with the holes in the screw sections. In other words, if slightly straightening one or more of the bends should result in giving the ends of the middle section of the arch too much buccal or lingual displacement to be in general harmony with the ends of the screw sections, the middle section, in the region of its ends, should receive additional modification of form to restore harmony with the anchorage when the middle section is again placed in position, so that unnecessary soreness or displacement of the anchor teeth may be avoided.

Dr. R. H. W. Strang, one of our number, has devised an ingenious instrument for recording the exact amount that the middle section of the arch is modified in the straightening at each appointment of the patient. Dr. Strang will later describe this instrument himself. If it is practical and will do what it so well promises, it will be a most valuable adjunct to orthodontic operations, for we can then for the first time actually measure the exact extent of movement of not only the crowns but the roots of any or all of the teeth, from appointment to appointment. This is progress; this is science.

FIG. 19.



A FEW ACCESSORY INSTRUMENTS.

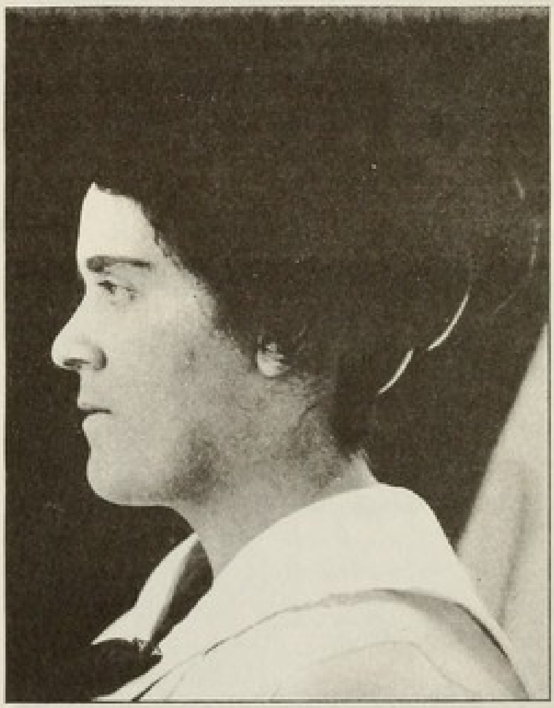
As a means for properly bending and straightening the middle section of the arch I have designed a pair of delicate pliers (Fig. 10), which I think you will find as efficient as they are simple.

I have already spoken of the importance of the form and position of the little notch in the middle section of the arch for the reception of the crescent end of the delicate pin during soldering. By far the most efficient instrument for this purpose I have yet found is the extremely delicate-edged file shown in Fig. 11. It should be kept for this purpose only.

I have also designed two other delicate instruments to aid us in this work. That shown in Fig. 12 is a reamer for enlarging the mouth of the little tubes, and that shown in Fig. 13 is a solder trimmer for trimming away any excess solder around the base of the pin which would prevent the proper seating of the pin in the tube.

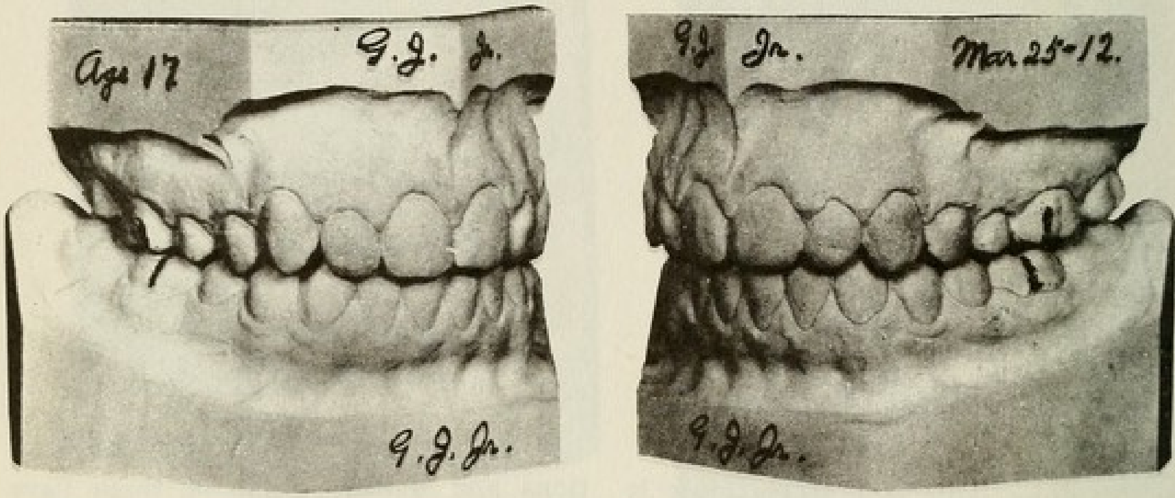
I am glad to be able to tell you that we will soon be able to procure the various parts of these appliances, together with the solder in the forms I have described, also the various instruments I have described, and others, for the orthodontic technique, and that all will be of the most excellent quality and of beautiful proportions and finish. Some of them have been sent us for use in the clinic today. I am greatly delighted with the accuracy

FIG. 20.



with which they have been manufactured, and I am still more delighted with the future possibilities for orthodontia in their intelligent use. But remember that at best the orthodontic appliances are only a factor in treatment—one of the means to an end, and let me incite you to a broader study of the basic principles of orthodontia, and especially of the tissues you operate upon, for orthodontia is no longer merely mechanics, but science.

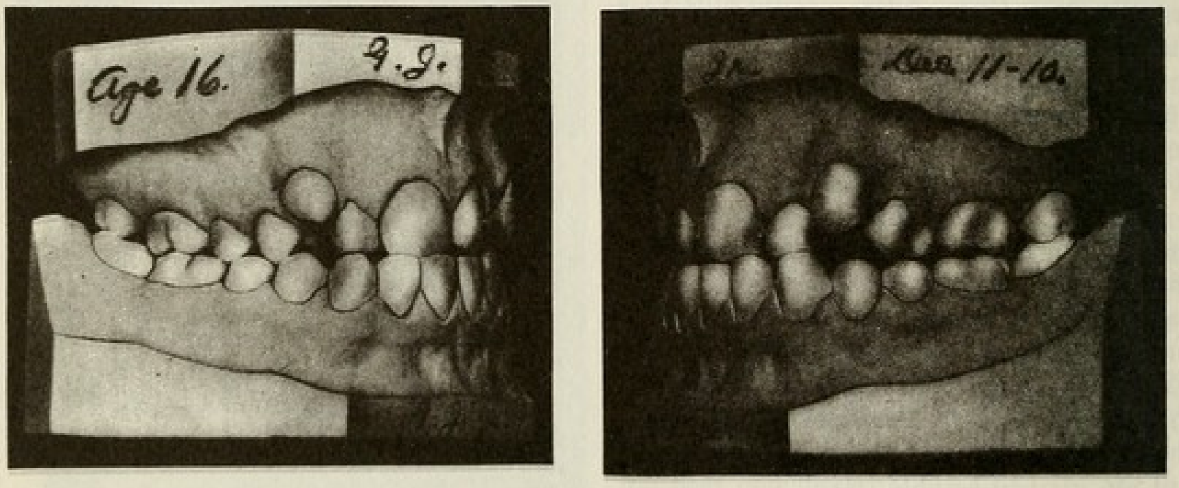
Fig. 21.



PRACTICAL RESULTS OBTAINED WITH THE IMPROVED APPLIANCES.

And now I want to show you some splendid results in the use of these appliances in a case treated by one of our number, Dr. A. H. Ketcham of Denver, who could not be with us today, but who has sent the report of this case. You will see that the results are such as could probably not have been accomplished by any other method of treatment heretofore employed.

Fig. 22.



The original conditions of occlusion and facial lines of the patient are shown in Figs. 14 and 15. The case was treated, up to a certain point, with the old appliances, exactly in the way in which we have all been treating similar cases, and very good results were accomplished, as you will see by the model and the face of the patient at this time, Figs. 16 and 17. We have all been quite happy over equal successes, but I do not think we will be content in the future to rest with such results. Dr. Ketcham was not satisfied with the occlusion nor with the resultant facial balance. So the new appliances were adjusted to the teeth of the upper arch with a view of inducing further bone growth and of gaining better angles of inclination of the incisors and cuspids. The ordinary expansion arch was adjusted to the lower teeth, and through its means the lower dental arch was enlarged and space provided for the missing lateral incisor, all as shown in Fig. 18. Now, if you will please study the occlusion of the case shown in the models in Fig. 19, after the completion of tooth movement, together with the facial lines of the young lady at this time (Fig. 20), I am sure you will feel, with me, that the result is simply wonderful. Dr. Ketcham will doubtless later report this case more fully himself, but the point I wish to here bring out is what has been accomplished in bone-building by the new method of treatment.

FIG. 23.

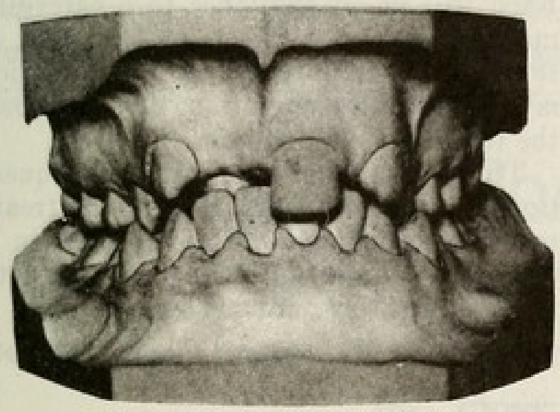
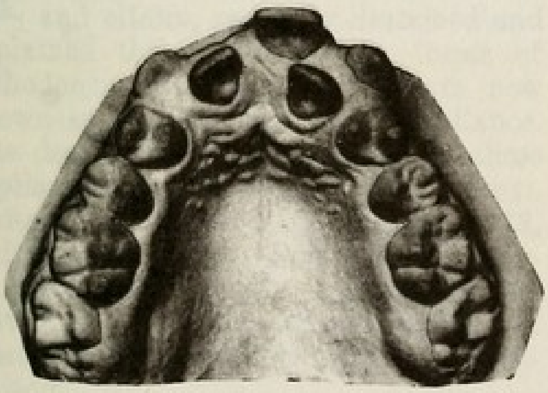


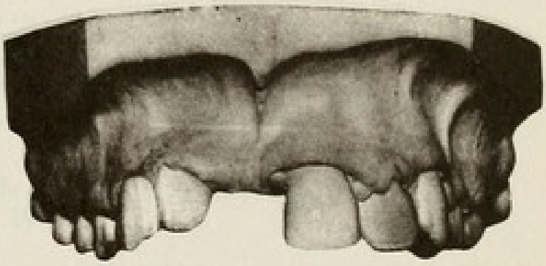
FIG. 24.



Of course the new appliances might just as well have been employed from the beginning of the treatment, both on the upper and lower arches, and I believe the results would have thus been accomplished more easily and quickly, with decidedly fewer appointments and the consequent conservation of much time of both patient and orthodontist.

You will remember that one year ago, in connection with the explanation of the new appliances, I also reported another case then being treated by Dr. Ketcham. Although splendid progress was shown in the treatment of this case, it had not been completed when I gave the report of it. So you will, I am sure, be pleased to see now the final results of Dr. Ketcham's work on this case, shown in Fig. 21, as compared with the original condition, shown in Fig. 22.

FIG. 25.



You will also be interested in the report of another case, treated by another of our members, Dr. Mendell of Minneapolis, wholly by means of the new appliances (Figs. 23, 24, and 25). Not only has there been extensive and pronounced bodily movement of the teeth, but most gratifying results in bone-growth.

Certainly the excellent results attained in these cases ought to be an inspiration to you all for deeper study and finer technique, and I sincerely hope that each and every one of you will be able to show equally gratifying results in the use of the new appliances in the reports of your cases at the meeting of this society one year hence.

PRACTICE CLINIC.

And now, gentlemen, in order that you may better familiarize yourselves with the various steps in the technique of adjusting the new appliances, I am going to give a clinic, but it will not be the kind of clinic that we have always been accustomed to, where men congregate around a chair or table to watch an operator do all the work. We will reverse this order and ask each of you to give the clinic himself, under the instruction of myself and Drs. Gough and Lane, who have been with me in my laboratory for several days specially fitting themselves to help you in this clinic. Every preparation has been made to enable you to do careful, thoughtful work in each detail of each operation, and I believe you will derive much practical benefit from this clinic.

Of course it would be impossible to provide actual patients for so many, and for our purpose this is not essential. Each will fit an appliance to a carefully made model of a practical case, but I repeat that the only true way in practice is to perform the operations directly upon the teeth of your patients.

There are many more interesting questions in regard to this method of treatment which cannot be brought out in a two days' clinic, but which we hope to reach at our next annual session.

THE
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ORIGINAL COMMUNICATIONS

Some New Forms of Orthodontic Mechanism, and the Reasons for Their Introduction.

By EDWARD H. ANGLE, M.D., D.D.S., Sc.D.

(Read before the Alumni Society of the Angle School of Orthodontia, New London, Conn., July 11, 1916.)

AT the last three meetings of this society I have, by means of lectures and clinics, carefully described and explained the use of certain forms of orthodontic mechanism which are now known as the "pin and tube" appliance. The description and discussion of these appliances are recorded in the DENTAL COSMOS for March 1910, August 1912, and January 1913. Complete familiarity with these articles is absolutely essential to a proper understanding of what I shall today offer for your consideration.

THE PIN AND TUBE APPLIANCE, AND WORTHLESS MODIFICATIONS.

The introduction of the pin and tube appliance undoubtedly marked a great step forward in orthodontic treatment, for with it was gained not only better control of force for the crown movements of teeth, but also it was the first practical mechanism for the proper control and distribution of force for the movement of roots of teeth, singly or collectively, and simultaneously with or independently of their crown movements. And, what is of still greater importance, with this mechanism the force for the movement of either crowns or roots can be applied and controlled in a manner that is far more nearly in accord with the requirements of the physiology of the tissues involved in tooth movement than with any other previously employed. It is well known that more nearly ideal results in occlusion and in bone development, as well as in facial development, have been gained by its use than was ever possible before.

Its use has become standard with the best orthodontists of this and other countries, and it is of course very gratifying to me to know that my predictions regarding its value have been verified. Yet it is a humiliating fact that many who are attempting the practice of orthodontia seem to be so lacking in judgment and in technical skill as to be unable to gain anything nearly like the measure of success that is possible in the use of this mechanism, or to appreciate the fact that correct forms and proportions and proper material for the construction of the various parts, with accuracy and perfection of workmanship in manufacture, are essential to its proper efficiency. The principal difficulty with most of these seems to be inability to properly locate the pins and attach them to the metal arch, and many indeed have been the modifications of the mechanism and the substitutes devised in order to overcome this to them insurmountable difficulty, and to obviate the necessity for acquiring technical skill and accuracy. In all instances delicacy and simplicity, and to a large extent efficiency, have been sacrificed. Indeed, some of the productions are so crude and clumsy as to be mechanical curiosities.*

Realizing how apparently hopeless to many is the mastery of the technique of this appliance, I have, after many months of careful thought and experimentation, succeeded in producing another type of mechanism—that which I am about to describe, and which, while retaining much, if not all, of the force control of the pin and tube appliance, possesses other advantages, besides being far easier to apply and operate. In fact it is so simple I think you will agree with me that there is now no necessity whatever for change of principle or modification of form, even by the habitual "modifier," that well-known type of practitioner whose greatest happiness seems to consist in modification of mere details in mechanism—nearly always to the detriment of the mechanism.

In presenting this new mechanism I fully realize the moral responsibility I must assume, or that anyone must assume when he attempts to add anything to the already very large number and variety of orthodontic appliances. If the added device be not truly useful and an advance beyond what has already been produced, better by far it should never appear, for it will not only cause unnecessary inconvenience and disappointment to many patients and orthodontists, and further add to the confusion of our literature and to the perplexity of the ever-increasing number who review it, but it will lessen confidence in its author. The usual crude modification or mere difference without distinction in principle is more often a step backward than forward, but there are reasons why, at this time, there should be additions to our orthodontic mechanism, additions that are real improvements, real inventions, the wonderful advances that have been made in the science of orthodontia in the past very few years having made necessary the rearrangement of our entire plan of treatment, and demanding decided betterment in orthodontic mechanism.

INJUDICIOUS EXTRACTION.

As you know, it was formerly the practice to extract one or more of the teeth that were most misplaced, hence most difficult to correct, or—what was often worse in effect—to extract others, usually two or more premolars, to "make room" for the malposed teeth. The crowns only of those that remained were then "pulled into alignment" without regard to what should be the true positions of either their roots or their crowns in the typal architectural line of the arch—the line of occlusion—or of their relations to the skull. The inevitable result of such radically wrong practice was to considerably diminish the sizes of the dental arches, thereby correspondingly impairing the function and lessening the efficiency of the denture, and rendering deficient the growth and function of the associated parts—that is, of the alveolar process, the nose, throat, tongue, lips, etc.—and marring the facial lines to an extent always noticeable and usually most unpleasing.

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* See *Items of Interest*, June 1914, and *Dental Summary*, May 1914.

That a plan of treatment so obviously illogical and unscientific should have so long been followed without question now seems most surprising, for, strange as it may appear to many, it is in most cases far easier to establish the normal in occlusion than to temporize in treatment, or to take the supposed short cut by the mutilation route, which can never be followed by satisfactory results because it is contrary to nature.

NECESSITY OF ESTABLISHING NORMAL FUNCTION OF DENTAL AND CORRELATED PARTS.

The duty of the orthodontist is not merely to "straighten teeth," but to restore the lost function or to establish the normal function of the denture and all its correlated parts. This means not only that normal relations shall be established between the inclined planes of the crowns of all the teeth which nature has decreed shall be present, but that their roots must also be given normal positions, with the necessary development of the alveolar process for their support. For be it emphasized that on the correct positions of the roots of the teeth depends to a very large degree the permanence of the normal relations of their crowns. Moreover, there must be established normal functions of lips, tongue, nose, and throat, for from these intimately related and highly interdependent tissues and structures come the auxiliary forces which must also be enlisted for the ultimate support of the teeth in their corrected positions. These forces are the permanent retainers which will hold the teeth in normal occlusion if normal, and in malocclusion if abnormal, in their functions.

Furthermore, it "follows as the night the day" that only in proportion as the forces of growth, development, and function of the denture and its correlated parts are normalized will there result true balance, beauty, and harmony of the face in accordance with its type. On this basis only can orthodontic treatment be permanently beneficial and truly satisfactory, for such only is in accordance with nature. And this is the true meaning of orthodontia.

INDICATIONS FOR EARLY TREATMENT.

Another important point should also here again be emphasized, namely, that children with developing malocclusion, which is always progressive, should not be put off on one pretext or another until they have reached the age of fifteen years, or until malocclusion and maldevelopment shall have about reached their maximum, but that treatment should be begun promptly as early as it is manifestly required, even in the deciduous denture, for at this early period is undoubtedly offered our greatest opportunity for the ultimate establishment of normal development and function of the permanent denture and all its associated parts. Yet I would at the same time also emphasize that the needless interference with child dentures, now so often done, cannot be too strongly condemned.

From the foregoing it will be seen that the scope of orthodontia has been greatly widened, and that the demand for the broader, deeper study of both the theory and practice of the science is imperative.

THE PHYSIOLOGIC APPLICATION OF FORCE.

As we have seen, the restoration of the denture to normal function demands not only the crown movement, but frequently the bodily movement of teeth. Tooth movement always involves bone-disturbance—bone-destruction and bone-growth—and these depend on the functioning of bone-cells, their activity resulting from mechanical stimulus—in orthodontic treatment from the stimulus of mechanical force from the appliances. We are, therefore, wholly dependent on the osteoclasts and osteoblasts in our efforts at tooth movement. As Dr. Frederick B. Noyes has well said, they are the true orthodontists; we but their directors.

If this interpretation of the demands

of nature in treatment is correct, more rational methods and more appropriate mechanism than have been generally employed are certainly needed, that we may have perfect control of the force necessary in the mechanical stimulus we are to give nature in her efforts at remodeling the denture.

Dr. Albin Oppenheim of Vienna, one of my former students, in his masterly, epoch-marking paper on his experiments on tooth movement in apes, given before this society in this city in 1911,* has proved conclusively that gentle force continuously applied will not only move teeth far more rapidly than great force, but that great force causes congestion and often wholly retards the functional activity of the cells for many hours together. This being true, how extremely important does it become that force from the orthodontic appliance for stimulating the activity of the bone-cells shall accord with the physiological needs of the cells—that is, that it shall not be too great nor too little in amount, that it shall be free from interruptions and disturbances, and that it shall be evenly distributed and continuously applied in the *right directions only*. Force wrongly applied, such as rapid and frequent changes in amount and direction, always inevitable in the use of faulty mechanism, greatly disturbs the normal activity of the cells and causes soreness, pain, inflammation, and sometimes even the death of the pulp, besides, possibly, permanent injury to the bone and peridental membrane. On the other hand, force physiologically applied is attended by the painless movement of teeth and normal reconstruction of the tissues.

REQUIREMENTS OF AN IDEAL APPLIANCE.

It must therefore be apparent that in order to be truly successful in meeting the present demands of treatment, orthodontic mechanism must perfectly control the amount, direction, and distribution of force for all necessary tooth movement, and at the same time that it must be of the greatest possible simplicity and delicacy. The ideal appliance would give gentle, constant force in the desired directions only. With it both the root and crown of a single tooth, or of all the teeth in the denture that require movement, could be moved in the same direction or in opposite directions, and, if need be, simultaneously. These movements, furthermore, would be painless, yet as rapid as is consistent with the physiological functioning of the cells of the alveolar process, peridental membrane, and gums. The ideal appliance would reduce to the minimum the inconvenience to the patient, as well as the time required for its first adjustment and for making the necessary subsequent changes. It would also move teeth in such strict accordance with the laws governing bone-absorption and bone-growth that there would be little if any need for subsequent retaining appliances, for by the time the teeth had attained their normal positions the bone would be normal in amount and structure. Hence it would be ample for the support of the teeth after the orthodontic appliances had been removed, provided of course that such correlated forces as were also previously abnormal had meantime been normalized—that is, forces from improper habits of lips, tongue, respiration, etc. — for I repeat that, without the normal support and cooperation of these there can be no assurance of permanence in the positions of the teeth that have been corrected. In a word, *the orthodontic mechanism should be in accord with and wholly subservient to the physical and physiological requirements of treatment.*

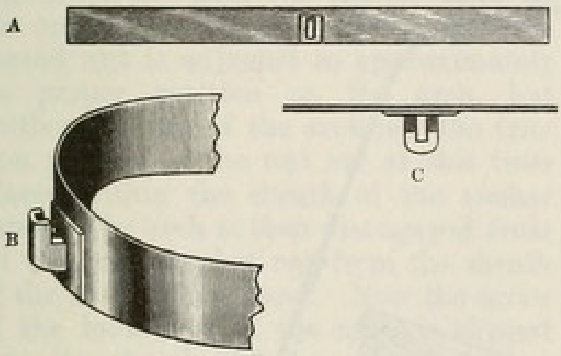
THE WRITER'S NEW DEVICES.

The forms of mechanism I shall now describe, if not strictly in accord with all the ideals set forth, will, I believe, upon careful analysis by competent judges, at least be found to be measurably nearer these ideals than any of the forms hitherto employed. They have not been hastily evolved, but are the result

* Published in the *American Orthodontist*, 1911.

of long experience, close and careful observation, and the closest consideration of every detail as to the material of which they are composed, their sizes, forms, proportions and relations of parts, the mechanical principles on which they are to operate, and the physical and physiological laws that are to govern their use. At the same time the object has been to produce an appliance which will be easy to understand and so simple as to reduce to the minimum the difficulties and exactions of the technique of both its adjustment and operation. This mechanism is of course based on that excellent main principle of the expansion arch given to us long ago by that great Frenchman, Fauchard, whom especially all orthodontists are honored in honoring. Some of the devices are but modified forms of my own former, well-known appliances; others are radically new. All are harmoniously proportioned, refined, and very delicate.

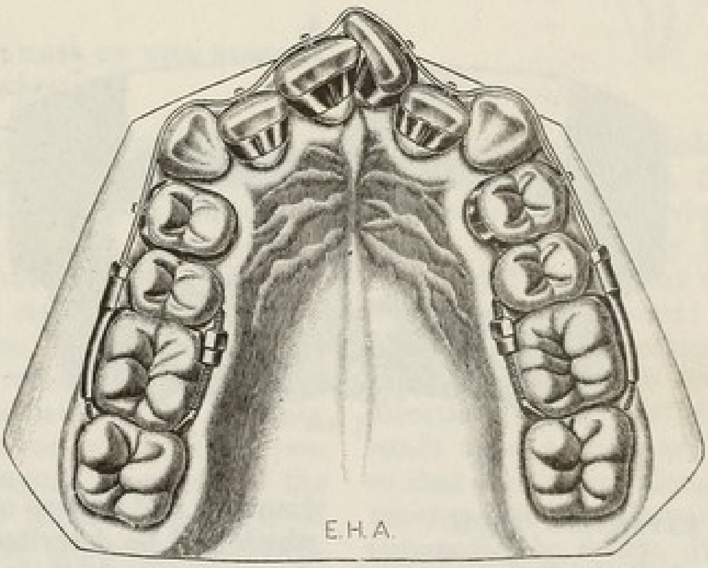
Fig. 1.



BRACKET.

A, Fig. 1, shows a delicate block of metal, or bracket, actual size, and B and C, Fig. 1, show it enlarged to facilitate description. All are shown attached to band material. The outer edge of the bracket is rounded, as are also its corners and its two ends, its sides being straight and parallel. Inwardly, a deep transverse slot extends downward in the bracket one-half the length of the bracket, terminating in a concave floor. The walls of this slot are parallel, one of them being formed by the band material and the other by the inside of the bracket proper. In the center of the latter wall is a delicate square perpendicular groove which passes downward and through the floor of the bracket. Its use will be considered later. The band material to which the bracket is soldered and which forms the inner wall of the slot is thickened at this point, which is very important, in order to give it the necessary strength. Fig. 2 shows several bracketed bands fitted and ce-

Fig. 2.



mented to the crowns of the incisors of an upper dental arch typical of those, especially in Class I, in which the teeth are crowded and the dental arches proportionately diminished in size. It will be specially noted that the seams of the bands have been formed on the lingual surfaces of the teeth, and that the brackets are located at the *center* of their labial surfaces.

FIG. 3.

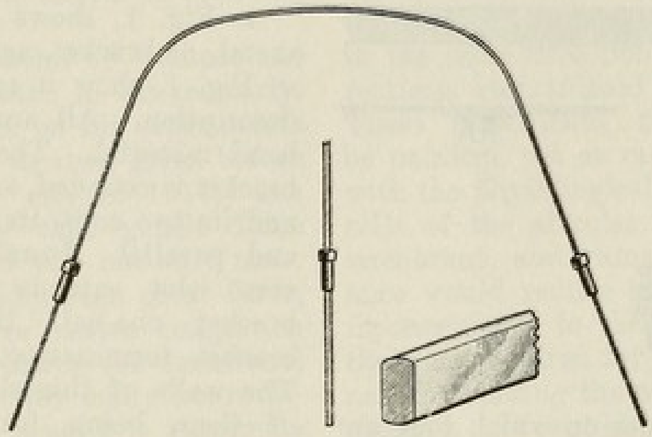
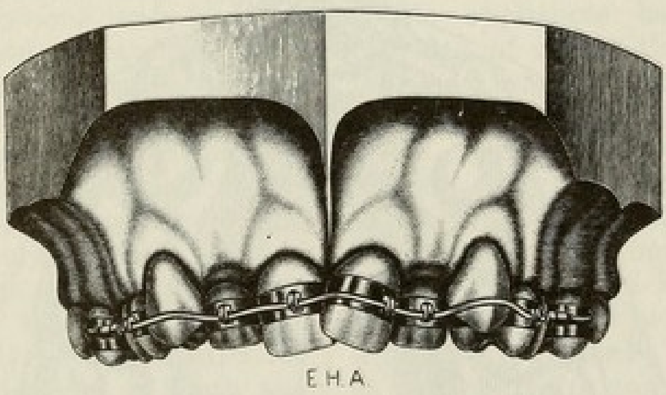


FIG. 4.



"RIBBON" EXPANSION ARCH.

Fig. 3 shows, in actual size, a very delicate, flat continuous, or non-sectional, expansion arch with parallel sides and rounded edges. It has, therefore, the form of a ribbon, and in order to distinguish it from the other forms of my expansion arches, I have called it the "ribbon" expansion arch. It is but twenty-two thousandths of an inch (.022″) in thickness and thirty-six thousandths of an inch (.036″) in width. Its ends are also flat, but threaded, and are provided with my well-known friction lock nuts, which have been greatly reduced in diameter in order that they may conform to the delicate proportions of this arch, which is used in connection with the usual anchor clamp bands, the sheaths of which are also reduced in diameter and possess other novel features which will be described later. They are shown on the teeth in Fig. 2. A transverse section of the ribbon arch, enlarged, is also shown in Fig. 3.

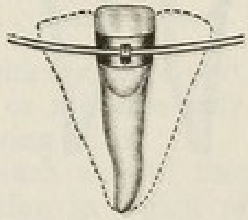
APPLICATION OF RIBBON ARCH.

In order to place the ribbon arch in position on the teeth, as shown in Figs. 2 and 4, one of its screw ends is inserted in the sheath of the anchor band on one of the first molars, and the friction lock nut is seated. The arch is then sprung with the fingers into the slots in the brackets, which it accurately fits, beginning with the one nearest to the first anchor band and proceeding in regular order until the anchor band on the opposite molar is reached, when the second nut is adjusted to approximately its proper position on the arch, but neither the end of the arch nor the friction portion of the nut are at this time placed within the sheath of the anchor band. The arch is then disengaged from all the brackets, but not from the sheath of the first anchor band. Now the screw of the loose end of the arch is slipped into its sheath on the second anchor band, and the nut seated. Then, beginning as before, the arch is replaced in the brackets in exactly its former relations, the last step being the proper seating and accurate adjustment of the second nut in its anchor sheath. Means for preventing the accidental displacement of the arch from the brackets will be considered later.

RANGE OF USEFULNESS OF THE RIBBON ARCH.

By studying the engraving, Fig. 2, it will be easy to understand the manner in which the force is applied to each of the malposed teeth in order to effect not only their individual, but also their collective movements. The elasticity of the arch, in this special case, operates constantly for the labial movement of the laterals, the torsional movement of the centrals, the buccal movement of the first premolars, and the lingual movement of the canines. And, as there is no waste of power through the slipping of attachments, the movement of the teeth must continue until the force from the elasticity of the arch as then bent has become exhausted, and the arch passive. Force is renewed by removing the arch and bending it to more nearly ideal form, when it is again sprung into place in the brackets and sheaths. By this means the teeth are moved continuously, until finally the ribbon arch has been given the exact form desired for the dental arch, and the teeth, through their bracket attachments, have been made to conform perfectly to it. As the metal of which the arch is made is very elastic, and as the ribbon form permits much greater range of elasticity than does a round arch, the force will be continued for a correspondingly longer period before it is necessary to remove the arch and modify its form. Indeed, but two or three modifications during the whole course of treatment would probably be enough in most cases. The force is gently and almost continuously operative in exactly the right direction, without the injurious disturbance of cell function which must follow the use of any mechanism that requires frequent removal and replacement.

Fig. 5.



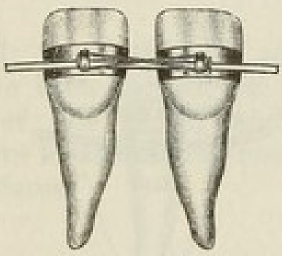
Another point which seems of great importance to me is that the force is distributed to the moving teeth automatically, each receiving its proportionate share both in amount and in direction. To explain this point: The peculiarity of the bracket attachment is such that the teeth may slide freely in a lateral direction upon the ribbon arch, like beads upon a wire, as shown in Fig. 5, so that each moves along the line of least resistance toward its normal position and automatically assists directly and indirectly in placing all the other teeth. In no other orthodontic mechanism is such complete reciprocality of movement possible.

Sometimes, however, it is desirable to prevent one or more of the teeth from sliding on the arch. This is done by soldering a very delicate spur upon the outer surface of the ribbon arch close to the bracket in such position as to prevent the sliding of the tooth.

As the teeth may slide freely on this arch, the closing of space between any two teeth, as for example two central incisors (see Fig. 6) may be effected by means of a metal ligature made to embrace the brackets upon the two teeth and occasionally renewed or tightened. (The two extreme sides of the ligature should be behind the metal arch, not in front of it, as shown in the engraving.) If it is desired to move one of the teeth only, the movement of the other may be prevented by the means above described.

Another point to be emphasized in the use of this mechanism is that the force is exerted upon the tooth wholly

FIG. 6.



through the bracket and not by bearing against any other portion of tooth or band. This accurate mechanical attachment not only permits the freer range of elasticity from the metal arch and consequently more ready distribution of the force, but prevents any possible unfavorable influence upon the teeth that are being moved. This is because the flat parallel walls of the metal bracket fit the parallel sides of the ribbon arch so accurately that teeth being moved outward, as the lateral incisors in Fig. 2, cannot be turned unfavorably by contact with adjoining teeth. Also, when rotation is desired, the force is exerted through the bracket and not by prying on a corner of the tooth. As the arch assumes its perfect form, the desired movements of the teeth take place in accordance therewith through the *accurate mechanical bracket relations,* Figs. 7 and 8. Heretofore rotation has usually been regarded as the most difficult of all tooth movements to accomplish. This is because complete force control has been impossible with the mechanism previously at our disposal. With the mechanism here considered, the force may be so continuous and evenly distributed that rotation becomes no more difficult than any other tooth movement. The principle employed is that of the double lever—two elastic levers operating with equal force in opposite directions.

FIG. 7.

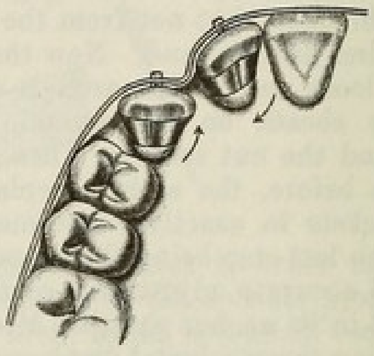
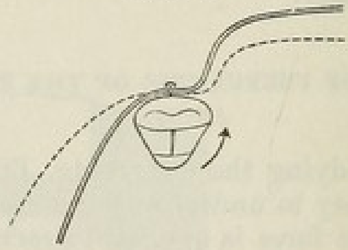


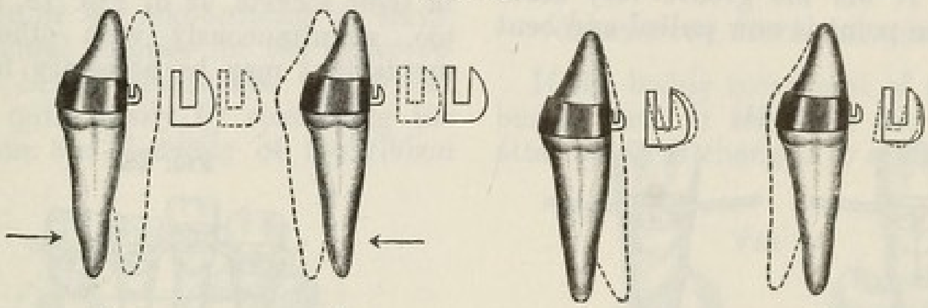
FIG. 8.



POSSIBILITY OF CROWN AND ROOT MOVEMENT.

To avoid confusion in discussing this mechanism, we have so far considered only the crown movements of teeth, but the distribution and control of force for root movement is equally feasible with it, either simultaneously with crown movement and in the same or in opposite directions, or independently of crown movement. The force from the elastic arch is distributed to the roots through the vise-like grasp of the arch by the brackets. (The direction of force upon the root depends upon the angle of inclination given to the parallel sides of the metal arch, before it is sprung into the brackets.) If the crown and root movements are to be equal and in the same direction, as in A, Fig. 9, where both are to be moved labially, or in B, Fig. 9, where both are to be moved lingually, the walls of the ribbon arch must be perpendicular before the arch is sprung into the bracket, so that the force will be distributed equally and in the same direction to both root and crown. If the labial movement of a root only is required, the ribbon arch is bent in the region of the bracket so that it will flare outwardly at the gingival border, and when sprung into position in the bracket will bind and exert force in a labial direction on the root of the tooth, as in C, Fig. 9. By flaring it inwardly, so that it will bind in the opposite direction when sprung into the bracket, the root of the tooth will be moved in a lingual direction, as in D, Fig. 9. So it is easily possible to move either root or crown to any degree, according to the form given the ribbon arch and the angle at which it is inclined in its bracket relations.

FIG. 9.

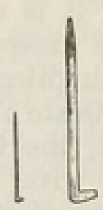


PERFECT CONTROL BY MEANS OF LOCK PIN.

Before considering other movements frequently necessary, such as elevation or depression of teeth in their sockets, the tipping of molars or other teeth to upright positions, or the bodily movement of teeth mesially or distally in the line of occlusion, let us consider another important feature of the mechanism, namely, the means of effectually maintaining the ribbon arch within the slot of the bracket. Unless the arch be free from the danger of accidental displacement and firmly maintained in the bracket slot to its full depth, there is a probability of *loss of power* and the lack of its *perfect control.* These two features are so very essential in orthodontic mechanism that their importance is at last being keenly recognized by our best orthodontists, and the many crude appliances in which a large part of the power is wasted or mischievously directed are rapidly losing favor.

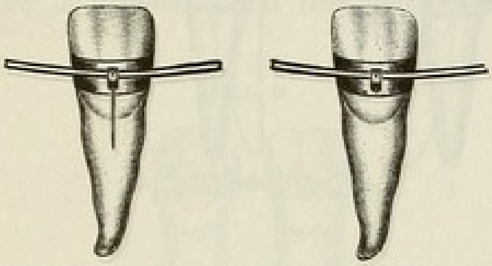
After much careful thought and experimentation in which probably most, if not all, of the possible means of maintaining proper arch and bracket relations were considered, a method was finally developed which seemed decidedly more efficient, simple, and practicable than any of the others. It consists in locking the arch in the bracket by means of a lock pin, shown in actual size at A, Fig. 10, and greatly enlarged at B, Fig. 10. It is very delicate—but ten thousandths of an inch (.010″) square—and pointed

FIG. 10.



at one end, the other end having a head which projects to one side. In shape it closely resembles the ordinary railroad spike, and is proportioned to give the greatest delicacy consistent with all necessary strength. The arch being firmly seated in the bracket, the point of the lock pin is inserted in the aperture of the square groove of the bracket, pushed down until it can be grasped with a pair of How pliers, and drawn through until its head rests in firm contact with the edge of the ribbon arch, A, Fig. 11. It fits the groove very accurately. The point is now pulled and bent

FIG. 11.



forward and upward and clipped off, thus firmly clinching it in position, as shown in B, Fig. 11. The roughened end is then smoothed and burnished so that it will not interfere with the lip.

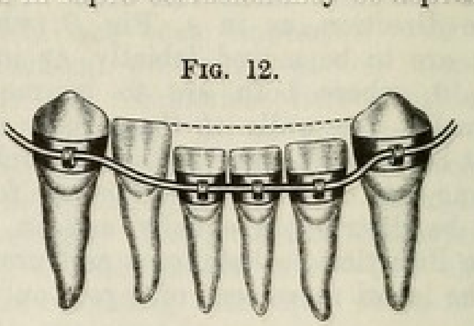
In this simple manner the arch is securely held, yet the lock pin is so delicate that, when it is in position, it is hardly noticeable except upon close inspection. By straightening its bent end by means of a delicate chisel or the blade of a small knife, the lock pin may be readily removed with the arch as the latter is lifted out of its socket connection.

CORRECTION OF INFRA- AND SUPRA-OCCLUSION.

Teeth that are in infra-occlusion may be elevated by springing the arch gingivally and keying it into its bracket relations by means of the lock pins, as in Fig. 12, the rapidity and extent of the movement being under the full control of the orthodontist.

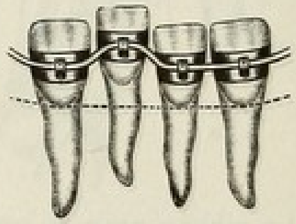
By reversing the direction of the force, teeth in supra-occlusion may be depressed

FIG. 12.



in their sockets, as in Fig. 13, and this, too, simultaneously with other movements that may be necessary for either

FIG. 13.

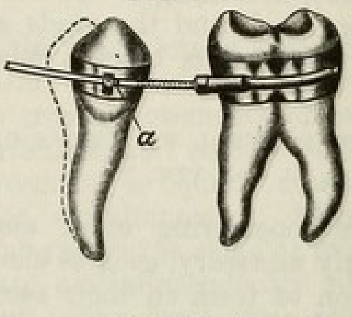


their crowns or their roots, as already described.

TIPPING TEETH TO UPRIGHT POSITION.

The demands of treatment also often necessitate tipping of one or more of the buccal teeth to upright position, which

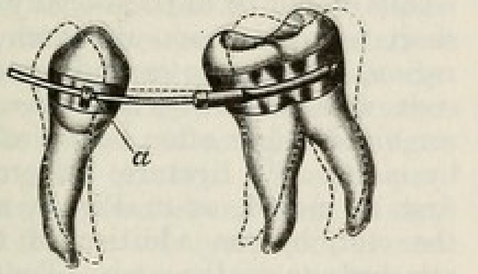
FIG. 14.



is easily accomplished after the manner shown in Fig. 14. Careful study of the device illustrated in this engraving will show how perfectly the force is under control for the hinge-like forward-tipping movement of the premolars as the nut is tightened, the delicate spur attached to the outer surface of the arch bearing against the distal surface of the bracket, *a,* while the anchor tooth offers full, even, and equal resistance throughout the entire alveolar connection without the possibility of its being tipped or the direction of force upon it being changed (stationary anchorage).

It is often desirable to tip the molar distally to an upright position at the same time that the premolar is being tipped mesially (see Fig. 15)—in orthodontic practice to regain space lost by mutilation or the non-eruption of teeth, and in dental practice for the better relation of bridge abutments. This may be done quite easily by combining the force from the elasticity of the ribbon

Fig. 15.



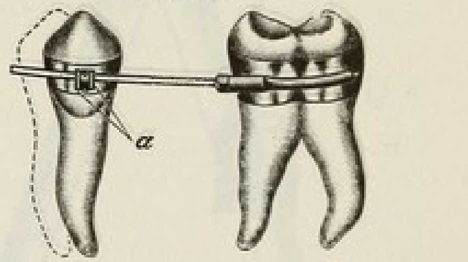
arch with that from the screw. The anchor band is adjusted on the molar so that the sheath will line below the band upon the premolar, Fig. 15. After the arch is seated in the anchor sheath, it is sprung upward into its bracket relation, thus exerting a constant pry upward on the anterior root and downward on the posterior root of the molar, plus the force in a distal direction gained by tightening the nut. The force is thus ideally directed and under perfect control, and will be found very effective.

Notwithstanding the great range in the elasticity of the ribbon arch when so employed, some of this elasticity would be lost in springing the arch up over the outer wall of the bracket of the band on the premolar, especially when the teeth are closer together than is shown in the engraving. This possible loss of spring may be completely obviated by reversing the position of the slot in the bracket when the band is formed about the premolar—that is, by placing the opening of the slot gingivally instead of occlusally. In this case the downward spring of the arch would be borne by the lock pin, which if properly applied would amply support it. The additional movement of rotation of either of these teeth may be accomplished simultaneously by bending the ribbon arch so that it will bind within the bracket or sheath, and exert rotatory force in the desired direction.

CLEATS FOR RIGID ATTACHMENT.

If the bodily movement of any of the buccal teeth is required, the hinge-like attachment is changed to a rigid attach-

Fig. 16.

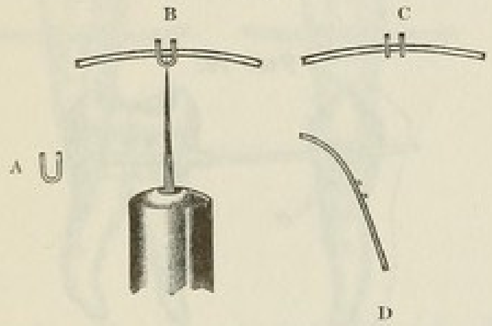


ment, *a,* Fig. 16, which will render tipping of the tooth impossible. This rigidity is gained by soldering two delicate square bars of metal (see *a,* Fig. 16) transversely to the arch, these bars or cleats being parallel and in contact with the mesial and distal surfaces of the bracket. The rigid attachment of the cleats to the arch and their close grasp of the sides of the bracket effectually prevent the tipping of the tooth, and necessitate its bodily movement as the nut in front of th anchor sheath is occasionally slightly tightened. Although simple and effective, the efficiency of the device depends wholly upon the accuracy with which the cleats fit the bracket.

FACILITATING THE SOLDERING OF CLEATS.

The soldering of two delicate bars of metal transversely to the arch so that they will be exactly parallel and at the same time separated only the exact width of the bracket is a feat in soldering that would tax the most skilful. After much thought and experimentation a plan was hit upon which not only insures accuracy but makes the operation a very easy one. The cleats are stamped from a sheet of metal so that the two are connected at one end, and they are separated by exactly the desired distance (see A, Fig. 17). This U form of metal is then easily soldered at any point on the flat arch, as at B, Fig. 17. The surplus portion of the U is then cut off, leaving the cleats as at C and D, Fig. 17, in mechanically correct relations. In order to still further simplify the operation it is hoped

FIG. 17.



that, in manufacturing, the solder may be rolled upon one surface of the metal before the U's are stamped. This would obviously be of great advantage, as it would then only remain to apply the proper flux and heat in order to attach them, and would insure the proper quality and quantity of solder and prevent its accidental displacement during soldering. Until this is done, very minute pieces of solder only must be employed, as any surplus solder will prevent the seating of the arch in the slot in the bracket.

VARIOUS APPLICATIONS OF CLEATS.

Again referring to *a*, Fig. 16, it will readily be understood that the root movement of the premolar may be easily accelerated or retarded by bending the ribbon arch slightly upward or downward just posterior to the cleat attachment, thus causing the cleats to bind upon the bracket as the arch is sprung into position. Or the same result will follow if the cleats are originally soldered at a slightly different angle on the arch from that at which the bracket is attached to the band.

In order to accomplish the bodily movement of incisors in a mesial or distal direction, as for example in Fig. 6, the crown movements of which have already been discussed, it is only necessary to apply the cleats to the arch so that they will engage the mesial and distal walls of both brackets upon the teeth. The force is then applied by the gradual formation of a loop or crimp between the two teeth, letting the crimp extend into the embrasial space between them—not forming a vertical loop, the banefulness of which I shall later point out.

Another way of accomplishing these results would be to occasionally cut very short sections from the arch in this region, and then to carefully reunite the ends with solder. These two methods combined might often be desirable. Or, by means of a ligature, the crown may first be moved, as in Fig. 6, and then the root, by the addition of the cleat attachments to the arch. For this the cleats would be so attached as to bind on the brackets, thus concentrating the force upon the roots in a mesial direction.

POINTS OF IMPORTANCE IN SHAPING THE RIBBON ARCH.

The ribbon arch should be so shaped that it will exert full force by its free elasticity through the bracket connections alone, as I have already pointed out, without touching the teeth,* as in Figs. 2, 7, and 8, and with as little interference with the lips as possible. In cases where the mal-arrangement of the teeth is not great, as in Fig. 2, the ribbon arch, without any preliminary bending,

* It will of course be impossible always to avoid having the ribbon arch touch intervening teeth, but this should be done whenever possible, as such contact interferes with the free elasticity of the arch, and consequently with force control.

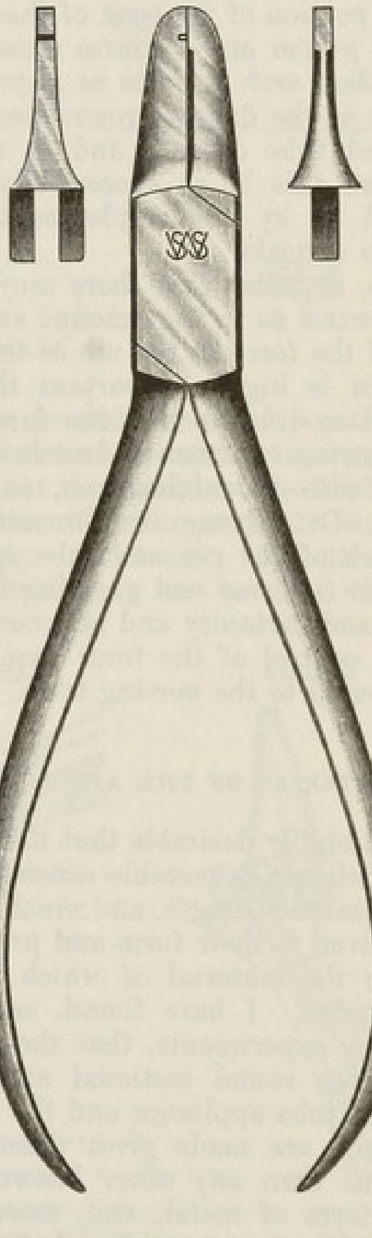
may be easily sprung into position in the brackets with the fingers alone. But where the teeth are in pronounced malocclusion, the arch must first be most carefully shaped outside of the mouth, wholly independent of the brackets, by means of pliers, in accordance with the positions of the teeth as shown by the plaster models. To bend it inside the mouth, assisted by the brackets on the bands alone, would require such great force that the bracket would certainly be strained and ruined, or the connection between band and tooth would be broken. This will apply equally to the finer shaping of the arch in order to cause it to bind within the brackets so that power may be applied in particular directions to individual teeth, as for rotation, or for root or bodily movement. Therefore, we would emphasize the fact that the arch must be so perfectly formed independently of the bracket in all instances that it may be easily seated with the fingers, or possibly with a piece of wood held in the fingers, to avoid the danger of straining the bracket. Thus the perfect fit between bracket and arch, so very necessary for perfect force control and so carefully worked out in manufacture, may be preserved.

Another point of much importance in the shaping of the arch is to avoid bending or marring it so as to change its form in the least at the points where it is to be engaged in the brackets. Any change would render it difficult or impossible to seat it without straining the bracket.

BENDING PLIERS.

So important is the proper bending of the arch that it has made necessary the special form of pliers shown in Fig. 18. Round-beaked pliers must not be used, but the new pliers illustrated are ideal for the purpose. The dimensions of the transverse slot (seen near the end of one of the beaks) corresponds exactly to those of the slot in the bracket. When the arch is placed in this slot, and the beaks are closed, it is held in the same manner that it would be in the bracket on the band, but more rigidly. It may now be bent as desired without marring it in any way and without changing the form of that part of it which engages the bracket slot, so that, when it is replaced, it will fit very accurately. No other method of shaping the arch insures such accuracy

Fig. 18.



of fit between arch and slot, and this is always of the utmost importance. In shaping the arch at specific points for accelerating or retarding root-movement, or for rotation, as in Figs. 8 and 9, these pliers are indispensable. This firm grasp of the arch and its steady support are also necessary while bending it edgewise upward or downward, as might be required in cases similar to those shown in Figs. 12 and 13, but for many reasons perpendicular bends in the arch, especially sharp bends, should always be avoided.

The usual necessary curves in the ribbon arch between the attachments may be made with the fingers or with the round portion of the beak of these pliers.

The proper and uniform annealing of the ribbon arch is quite as important as is that of the delicate round arch of the pin and tube devices, and in no other way can this be so successfully accomplished as by the employment of the electric annealer.

Also, in order that there may be perfect control as to the amount and direction of the force in the use of the ribbon arch, it is highly important that each and all modifications in the form of the arch during treatment be made in accordance with the archograph, as pointed out by Dr. Strang in connection with the arch of the pin and tube appliance. Only in this way can guessing be eliminated and certainty and accuracy gained in the control of the force that is to be distributed to the moving teeth.

MATERIAL OF THE APPLIANCES.

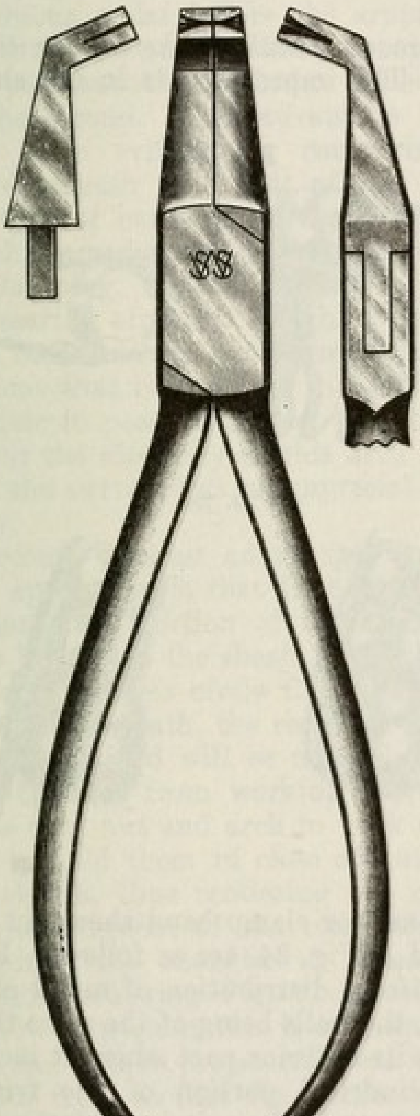
It is highly desirable that the brackets be as delicate as possible consistent with the required strength, and much care has been given to their form and proportions and to the material of which they are constructed. I have found, as a result of many experiments, that the metal of which the round sectional arch of the pin and tube appliance and the new ribbon arch are made gives them greater strength than any other known practicable form of metal, and, more important still, the strength of this metal is not impaired by the heat necessary in soldering the bracket to the band. Since much accuracy and skill are required to properly attach the brackets to the bands, and as it is never necessary to change their positions on the bands, they will only be supplied by the manufacturers already attached to sections of the reinforced band material.

NEW CONSTRUCTION OF BANDS.

The band material is furnished in both precious and non-precious metals, and in two different lengths, for large and small teeth. The strain upon the band laterally in rotation, and perpendicularly in root-movement, is so great that it would injure the ordinary band of uniform thickness. This has been overcome by thickening, hence strengthening, the band in the region of the attachment of the bracket where the strain is concentrated, and making it thinner where the strain is diffused, as between the approximating surfaces of the teeth. This is an important improvement in band-making, and in time it will doubtless be employed to advantage in the construction of most orthodontic bands.

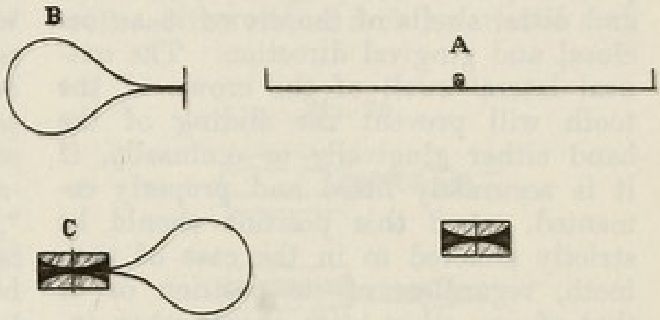
Band-holding pliers. The present standard method of making plain bands, especially of non-precious metals, is to use a piece of band material long enough so that its two ends may be firmly grasped by one hand and drawn tightly about the tooth, while it is pinched with my band-forming pliers held in the other hand. But the expense of precious metals, especially of alloys which contain platinum, renders highly desirable the use of strips of band material of the shortest practicable lengths. This has necessitated some form of instrument to take the place of the fingers for holding the ends of the pieces. Dr. Grünberg has suggested soldering the ends of each piece together and exerting pressure on the loop so formed by means of a right-angle ball-end burnisher. The plan is a good one, but it requires extra time and trouble to unite the ends. To avoid this necessity, Dr. Frederick B. Noyes suggested to me the possibility of using some form of pliers for grasping the ununited ends of the band material, and showed me a pair of obtuse-angle How pliers which he was using for that purpose with some degree of success. Acting on Dr. Noyes's suggestion, I have, after much experimenting, produced a pair of pliers which, I think, fully meet the requirements, and which are at the same time very simple in design and applicable to either the lingual or labial surfaces of the teeth of ner arch. The beaks of the pliers are flat, close-fitting, and stand at an obtuse angle to the handles (see Fig. 19). Each jaw is provided with a transverse slot for the reception of the two thicknesses of band material. A piece of band material of the proper length is bent sharply at right angles near both ends,

FIG. 19.



as in A, Fig. 20. These bends are best formed in the slot with which one of the handles is provided, thus insuring uniformity in their length. The band material is then formed into a loop, B, Fig. 20, the ends are seated in the slot in one of the beaks, and the handles closed, C, Fig. 20, thus giving the firmest grip to the bent ends of the band material and the firmest support to the band. The loop is then worked over the crown of the tooth to the desired position, the pliers serving as a most convenient handle for this purpose, as well as for firmly drawing it about the tooth while it is being pinched by my band-forming pliers (see Figs. 21 and 22).

FIG. 20.



It is thus possible to employ pieces of band material of the minimum length—so short that they could not be held with the fingers. The instrument is very satisfactory. Of course, long pieces of band material may also be used with it,

FIG. 21.

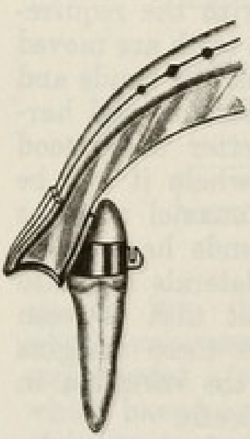
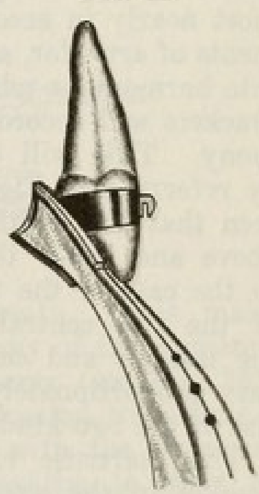


FIG. 22.



the surplus material passing out between the beaks of the pliers.

A few words here as to the positions the plain bands should occupy on incisors and canines will not be amiss, as, to my knowledge, no definite location for these bands has ever been indicated by any author, the result being a very great lack of uniformity in the placing of bands in individual mouths, and this results not only in instability of attachment, but in a pronouncedly inartistic appearance. In fact, there is but one correct position for a band to occupy on each individual tooth, because only in this position can it afford the greatest firmness and stability of attachment. This position is transversely to the crown of the tooth, and the band should be so placed as to embrace equally the mesial and distal swells of the crown in an occlusal and gingival direction. The natural lateral swell of the crown of the tooth will prevent the sliding of the band either gingivally or occlusally, if it is accurately fitted and properly cemented. And this position should be strictly adhered to in the case of each tooth, regardless of its position or of that of any other tooth except when incomplete eruption of the tooth makes the correct placing of the band temporarily impossible.

Also, whenever possible the bracket should occupy a position in the center of the labial surface of the band on a line with the axis of the tooth. The band and bracket being thus correctly placed mechanically, they will also be most nearly in accord with the requirements of art—for, as the teeth are moved into harmonious relations, the bands and brackets will accord in balance and harmony. This will be better understood by referring to Fig. 4, where it will be seen that the width of enamel margins above and below the bands harmonizes in the case of the two laterals and also of the two centrals, but that between the laterals and centrals these margins vary proportionately to the variation in size of the two kinds of teeth.

The inartistic effect of placing the bracket in the wrong position is strikingly shown on the left central incisor, Fig. 4, which is an error in the engraving. Had it been placed in the center of the band, as shown to have been properly done in the case of the other central and both laterals, the brackets and intervening spaces on the bands would have been in harmony and balance and would have been far more pleasing in appearance than is now the case. The inartistic arrangement, as shown, is the same as would result were four pictures hung in as many spaces upon a wall, one of the pictures being wrongly placed as to its space.

Finally, the forming of seams in bands labially is so manifestly out of keeping with correct technique and so pronouncedly inartistic in appearance that only the most careless and slovenly operators continue to make bands in this way.

Improved sheath of the anchor clamp band. The improvements in the sheath

FIG. 23.

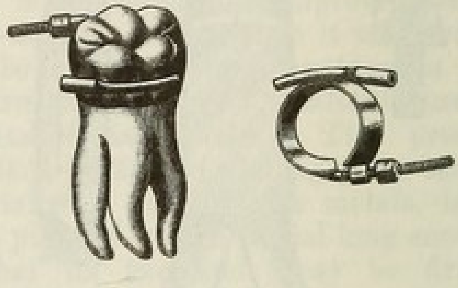
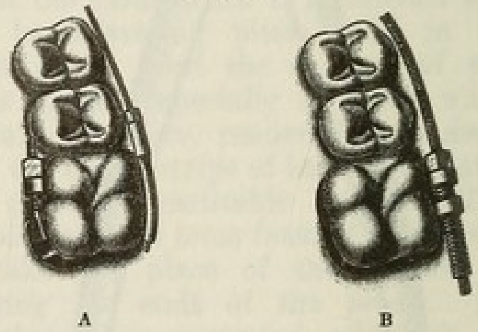


FIG. 24.



of the anchor clamp band shown in Fig. 23, and A, Fig. 24, are as follows: First, the uniform distribution of metal of the sheath, the walls being of the same thickness in its anterior part where it incloses the cylindrical portion of the friction lock nut, and where it is subject to the greatest strain and liability to injury, as in that part which incloses the threaded portion of the arch. This gives the same close adaptation to the arch as to the cylindrical portion of the nut, and reduces the bulk of the sheath to the minimum. Second, the main body of the sheath has been uniformly bent to form the arc of a circle.

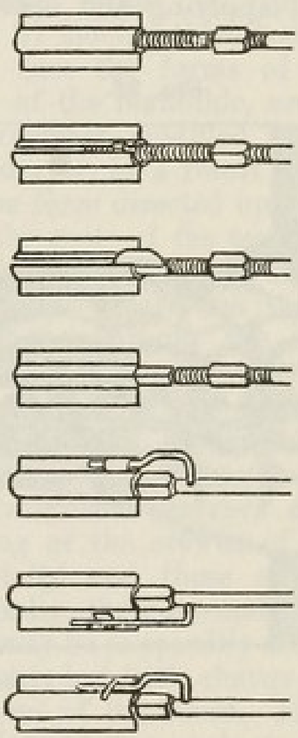
Advantages of the curvilinear sheath. This sheath has many decided advantages over the straight sheath, which will be readily appreciated by both orthodontists and patients.

First, the distal end of the sheath lies much closer to the disto-buccal angle of the tooth (see A, Fig. 24), thus avoiding all interference with the cheeks. The straight sheaths formerly necessary frequently caused abrasions of the cheeks, especially when employed on the second deciduous molar before the eruption of the first permanent molar, or upon the first permanent molar before the eruption of the second. This advantage will be still more evident on comparing the curved sheath with that of the Oettinger type of band shown at B, Fig. 24,* which, in order that it may be revolved in clamping, requires a very large and necessarily straight sheath. The fact that the sheath is curved might suggest to some that it would be difficult or impossible to pass the ribbon arch through it, but the elasticity of this arch is such that the curve offers no appreciable difficulty.

Second, another advantage which all will appreciate is that if, before its insertion, that portion of the arch which is to lie within the sheath be bent to the arc of a smaller circle than that of the curvilinear sheath, the result of the elasticity so gained will be not only to prevent the nut from working out, but to cause both nut and arch to work distally and to hold them in close apposition to the sheath, thus rendering the accidental displacement of the nut impossible. Keeping this thought in mind while carefully studying Fig. 2, one will realize how important this is in keeping the arch and nuts in proper relations with the anchor teeth so that the former will not work forward and possibly permit spaces to appear between the teeth during treatment. This is an annoyance which all have experienced in the use of all other orthodontic mechanism with which we are familiar, and which has often made necessary the use of extra ligatures or other attachments to prevent the arch from sliding forward.

Third, the curvilinear sheath gives the best control over the direction of force for moving the roots of the anchor teeth either buccally or lingually, in connection with or independently of their crown movements. The curved sheath effectually prevents the turning of the ribbon arch within it, thus insuring complete control over the force according to the degree of perpendicularity of the walls of the ribbon arch before the arch

Fig. 25.



is slid into the sheath. This makes wholly unnecessary any of the numerous complicated attachments (see Fig. 25*) which have been advocated from time to time in connection with the expansion arch and straight sheaths, to effect the buccal or lingual movement of the roots of anchor teeth.

Fourth, with the curvilinear sheath a longer arch can be used than with a straight sheath. The ends of the arch may pass through it an eighth of an inch or more, for they are so delicate and lie so close to the adjoining teeth

* This band was invented by Dr. Oettinger, of Missoula, Montana.

* Pullen: Johnson's "Operative Dentistry," page 684.

that they cause no interference with the cheeks.

Occasionally, also, advantage may be taken of this elastic projecting end of the arch to apply pressure upon the distally adjoining tooth for its lingual movement, or to assist in the buccal movement of the anchor tooth.

ESTABLISHMENT OF NORMAL MESIO-DISTAL RELATIONS OF TEETH OF OPPOSING ARCHES.

After the foregoing description of the manner of applying and operating the mechanism for accomplishing both crown and root movements either singly or collectively in either or both dental arches, it should be easy to understand how it may also be applied and operated, in addition to and simultaneously with these movements, in order to establish the normal mesio-distal relations of teeth of opposing dental arches in the very distinct types of malocclusion belonging to Classes II and III, and illustrated in Figs. 26 and 27.

Fig. 26.

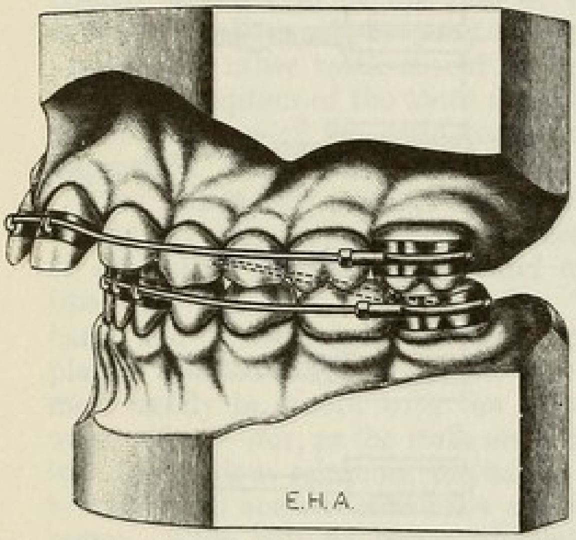
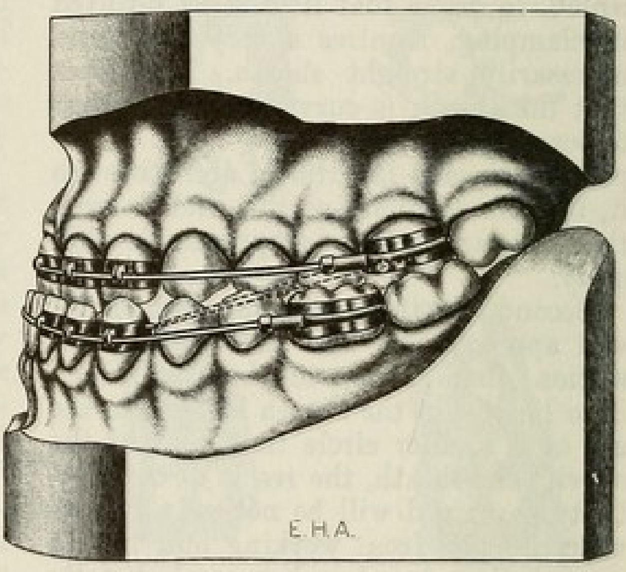


Fig. 27.



The requirements of treatment of individual cases of these types of malocclusion vary considerably, depending upon the extent of the deformity, the age of the patient, arrest or modification of bone-development, etc. Yet in one respect they are always the same, namely, that proper form must be given to each dental arch, and that any existent malposition of individual teeth must be corrected. Then, when the mesio-distal relations of the dental arches have been corrected, the arches will harmonize as to size, form, and other relations, and the teeth of the two arches will occlude normally. Of course, all these various changes may be brought about simultaneously, but in these cases there are two distinct classes of movements, and this fact should be kept clearly in mind throughout the entire course of treatment, with efforts logically directed accordingly.

APPLICATION OF INTERMAXILLARY ELASTIC LIGATURES.

The normal mesio-distal relations of the dental arches must be established by changing either the forms of the jaws, especially of the mandible, or the relations of the crowns of the teeth (by tipping or by bodily movement), or both. The mesio-distal changes are effected largely through the force from intermaxillary elastic ligatures used in connection with the mechanism we are here considering.

In cases belonging to Class II, the intermaxillary ligatures engage the distal ends of the sheaths of the bands on the lower first molars and delicate hooks attached to the lower margin of the upper ribbon arch, as indicated by the dotted lines in Fig. 26. In Class III (see Fig. 27), the positions of the elastic ligatures are, of course, reversed, and engage the distal ends of the sheath of the upper anchor bands and hooks attached to the upper margin of the lower ribbon arch. Of course, the intermaxillary force as here used is the same as that which we have long employed in connection with the expansion arch E.

In treating the malocclusion of a typical case belonging to division 1, Class II, as illustrated in Fig. 26, the first stage of the operation, as we have said, is to correct the form of each dental arch and the malpositions of the individual teeth; the second, to establish the normal mesio-distal relations of the two arches.

The general form of the lower dental arch in these cases is usually quite normal, but the upper arch is commonly narrowed anteriorly, with characteristic protrusion of the incisors. This necessitates its being widened in the region of the canines and premolars and shortened by tipping the incisors lingually. The latter movement should be undertaken first, and by keeping the nuts in front of the upper anchor teeth turned forward about half the length of the friction sleeves, the free movement of the arch distally through the sheaths is permitted, and all of the force of the intermaxillary elastics is concentrated upon the incisors.

Considerable force for the distal movement of the ribbon arch through the anchor sheaths, in addition to that from the intermaxillary elastics, is to be derived from the elasticity of the arch by reason of the curves in the sheaths, as already described in connection with this peculiar form of sheath. This force should be kept active by occasionally bending to their proper forms those portions of the ribbon arch which lie within the sheaths.

As the incisors are tipped lingually, they will tend to wedge the canines and premolars outward, thus widening the anterior part of the dental arch, and in many instances it will thus be sufficiently widened. However, if more direct force be required, the elastic ribbon arch may be used with bracketed bands on these teeth, as in similar movements already described, and illustrated in Fig. 2.

When the work of reshaping the dental arches is well under way, attention may be specially directed toward establishing their normal mesio-distal relations.* This is effected by intermaxillary force, changing the relations of the opposing teeth either by tipping their crowns or by moving them bodily. Also, in either case the forms of the jaws, especially of the mandible, are probably always favorably modified to a greater or lesser degree, as a result of the stimulus of the force directed upon the bones through the roots of the teeth. The extent of the change in the form of the bones depends greatly on the age and health of the patient, the amount of force, the length of time it is operative, and the manner of its distribution to the bones through the attachments of the mechanism on the teeth. That is, if the attachments are such as to favor the tipping of the crowns of the upper teeth distally and those of the lower teeth mesially, their normal mesio-distal relations may be so speedily accomplished that probably but little change will result in the forms of the bones. If, however, the attachments are such as to prevent the tipping of the crowns, but necessitate their bodily movement if moved at all, the operation will necessarily require a longer period of time. The force will also be more favorably distributed to stimulate the growth of the bones, with consequent greater and more favorable

* In favorable cases of young patients where the malocclusion is of recent origin, and before the mandible has become extensively modified in form so as to be in harmony with the malocclusion, the simple truing of the arches, rendering possible and easy the closing of the jaws with the teeth in their correct mesio-distal relations, is the only treatment necessary, but the percentage of such cases is small.

modification of their forms. This is highly desirable, as improvement in the shapes of the bones in these deformities should be one of the very important objects of treatment, especially when the mandible is of abnormal form, as it nearly always is in typical, well-developed cases.

TIPPING OF UPPER TEETH DISTALLY AND LOWER TEETH MESIALLY.

When the normal mesio-distal relations of the dental arches are to be established chiefly through the *tipping of the teeth* of the upper jaw distally and those of the lower jaw mesially (in Class II), the ribbon arches must be given such form in their bracket and anchor sheath relations as will permit or favor this movement, and not bind in their attachments and prevent it. This necessitates that the sheaths on the upper anchor teeth should align, not horizontally, as shown in Fig. 26, but slightly obliquely, with the mesial end the higher, so that, when the upper ribbon arch is placed in position in the sheaths, and before it engages the brackets, its anterior part will lie as high or higher than the margin of the gingiva, requiring it to be sprung downward to engage the brackets. The result will be to pry downward on the mesial ends of the anchor sheaths and upward on the distal ends, thus contributing measurably to the force from the intermaxillary elastics to tip the anchor teeth distally. At the same time the force exerted by the anterior part of the ribbon arch in an upward direction will tend to compress the incisors in their sockets. This is often desirable, especially when, through lack of proper function, these teeth are found in supra-occlusion, as they usually are to a greater or less degree in these cases. This prying force of the arch may be maintained, when required by the distal tipping of the teeth, by slightly bending it upward at points somewhat anterior to the friction lock nuts.

Of course it is quite as necessary for the upper buccal teeth anterior to the anchor teeth also to be tipped distally. This is done by placing bracketed bands upon the canines, the brackets engaging the ribbon arch, while delicate spurs, attached to the outer surface of the arch, bear against the mesial surfaces of the brackets, after the manner already described, and shown at *a*, Fig. 14. The result of this spur and bracket attachment to the canines, with the nuts on the arch acting against the anchor sheaths, is to distribute the force equally and directly to tip distally the canines and anchor teeth, and indirectly, through contact, the intervening premolars.

The same principle is applied for the mesial tipping of the lower teeth, but the direction of force through the pry of the lower ribbon arch is reversed by aligning the sheaths on the lower anchor bands so that the anterior part of the arch will line higher than the occlusal edges of the incisors before it is sprung downward and locked within the brackets. However, it is now my opinion that the lower teeth in these cases rarely, if ever, require tipping, but, on the contrary, that this should nearly always be prevented from the beginning.

BODILY MOVEMENT OF TEETH OF ONE OR BOTH ARCHES.

When the bodily movement of the teeth of one or both arches is to be accomplished in order to establish the normal mesio-distal relations of the opposing teeth (Class II), their attachment to the metal arches must be rigid to prevent tipping. This is made easy by bracket and band attachments, as shown on the lower incisors in Fig. 26, with additional bracket, band, and cleat attachments on the canines, and, usually, on the first premolars, after the manner shown in Fig. 16. The ribbon arch must then be given such form in its relation to these attachments as to bind and prevent the tipping of the teeth. As the description of these attachments has already been given in connection with Figs. 9, 15, and 16, its repetition here is unnecessary.

Similar mechanism may be attached to the teeth of the upper arch, but in such manner that the direction of force from the binding of the arch in its attachments will be reversed, thus distributing the intermaxillary force distally to the roots of the upper and mesially to those of the lower teeth.

Another result of such application of force is, as we have said, to modify the forms of the jaws, especially of the angles and rami of the mandible, which has been proved to have been done in numerous cases reported.

The same principle of attachment and of force control will apply for effecting the crown or root movements, or bone changes in the mandible, in the treatment of cases belonging to Class III.

SUMMARY OF ADVANTAGES OF THE NEW DEVICES.

From the foregoing it will be apparent that the force may be so controlled as to permit or to prevent the tipping of any tooth or teeth to any extent, or to compel the bodily movement of any tooth or teeth in either or both arches.

It will have been noted that this mechanism is of the greatest simplicity, of the maximum delicacy of parts, and with all unnecessary material eliminated. Hence it is of the least inconvenience to patients and the easiest to keep cleansed. It would seem that the mechanism is nearly ideal, not only for securing the necessary static force for anchorage and of dynamic force for tooth movement, but for directing and controlling this force so that all cellular change attendant on tooth movement most nearly accords with the laws of physiology. It is also graceful in its proportions and not unpleasing in appearance. In a word, the principles of mechanics, art, and physiology do not conflict, but are made to harmonize beautifully and as was never possible in orthodontic mechanism before. It is so simple and easy to apply as greatly to lessen the usual work of the orthodontist and the usual number of visits of patients. It is not expected that it will wholly supersede the pin and tube mechanism, neither will it wholly supplant the expansion arch in its round form with ligature attachments. In fact, the ligature attachment will be found to be of advantage in connection with the ribbon arch in the movement of premolars and of other teeth that may be so pronouncedly misplaced as to render impracticable the bending of the ribbon arch to gain bracket attachment with them until after they have first been moved into more favorable positions by means of ligatures. But in the great majority of cases the mechanism herein shown will be found to possess such obvious advantages in force control and in ease of application and operation, that I believe it will find a permanent place in orthodontia.

In concluding the description of this mechanism, let me say that I have given such close thought and care to perfecting it in all its details, and have been so ably supported by the manufacturers, that I feel sure it cannot be improved by modifications or additions, at least not until you give it years of thought and study, as I have. Therefore let me earnestly advise that, instead of attempting to modify it, you devote your energies to understanding it and its possibilities, and to perfecting your skill in the technique of its application and operation. In this way your opportunities for self-improvement will be greatest, and you will be able to confer the greatest amount of good on your patients. Apt in this connection is the remark of the great surgeon, Hamilton: "It is not in the discovery and multiplication of mechanical expedients that the surgeon of this day declares his superiority, so much as in the skilful and judicious employment of those which are already invented."

REPORT OF CASES TREATED WITH THE NEW MECHANISM.

Recently I have treated with this mechanism a typical case belonging to Class II, division 1, the characteristics of which were very similar to those illustrated in Fig. 26, except that the "overbite" was greater. During this treatment I believe I have made a valuable discovery, and one which should henceforth greatly lessen one of the annoying difficulties which we frequently encounter in the treatment of these cases—namely, in securing and maintaining the proper height or "bite" of the teeth. I am sure it is the common experience of all of you that in typical, well-developed cases belonging to this class, you frequently find what is apparently infra-occlusion of the molars and supra-occlusion of the incisors, both upper and lower, so that the cutting edges of the lower incisors are often in contact with the mucous membrane of the lingual gingiva of the upper anterior teeth, or even with that of the hard palate. And this improper height of the teeth remains to a greater or less degree after the correct mesio-distal relations of the teeth have been established, necessitating "bite bands" or "bite plates" or other devices, to be worn for long periods, to effect the shortening of the incisors and lengthening of the molars.

In the treatment of the case in question I gave plenty of spring in a gingival direction to the anterior part of the ribbon arches for both upper and lower dental arches, so that when they were engaged in the brackets on the incisors there was a constant tension upward on the upper incisors and downward on the lower ones. The result has been not only the shortening of the incisors, but a compensating lengthening of the molars, in obedience to the law of physics that action and reaction are equal and opposite. In other words, the force which operated to compress the incisors within their sockets acted to an equal extent in the opposite direction (or reciprocally) for the elevation of the molars, and this simultaneously with the mesio-distal adjustment of the teeth of the two arches. I even carried this movement a little farther than normal, a practice I have long followed in the movement of all teeth, thus allowing for their possible slight recession after the final removal of the appliances, which in this case will of course be worn passively, for retention, for some time yet.

Another feature in connection with this case, which will surprise many of you who consume an inordinate amount of time in the treatment of cases, is that the entire operation of treatment was accomplished practically within eight weeks. I wish, however, to explain that I was testing the control of the mechanism in this case rather than aiming to comply strictly with the requirements of physiology, which would logically necessitate a somewhat longer period for treatment. I have, however, observed no undue soreness of the tissues. In fact, never before have I treated a case with apparently so little unfavorable disturbance of the tissues.

My patient is with us today for your inspection of his teeth and of the appliances which are still in position upon them. The models of the case at the beginning of treatment, and several study models during its progress, are also here for your inspection. One of the study models also reveals the verification of my prediction that the spring from the ribbon arch alone acting within the curvilinear sheath would carry the ribbon arch distally. In this case it carried the two upper central incisors with it to a marked degree during the first ten days of its operation, or before the application of any intermaxillary elastics; even before the attachment of the sheath hooks. This Dr. Gough can verify, as he saw the case at the time the sheath hooks for the reception of the elastic ligatures were attached to the upper ribbon arch.*

The first two cases on which this mechanism was used were treated by Dr. G. P. Mendell of Minneapolis, Minn. The appliances were adjusted to the first case on May 20, 1913, and to the second case soon after this date. The pictures of the latter case I will here show, giving but a brief description of them, leaving the more detailed account of the

* The pictures to illustrate this case are too late for publication, but will be shown in my forthcoming book, together with those of other cases treated with this mechanism by myself and by Drs. Gough, Strang, Mendell, and Ketcham.

treatment of both this and the first case to Dr. Mendell, who is with us today

FIGS. 28 AND 29.

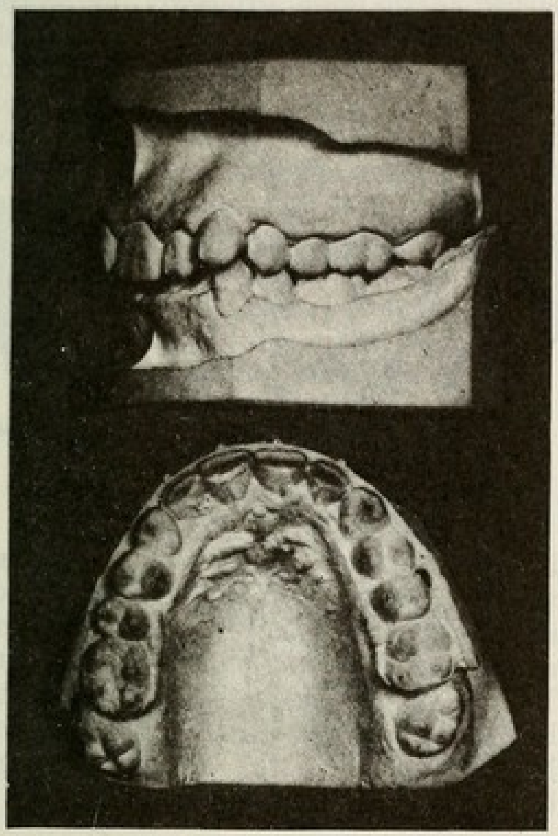
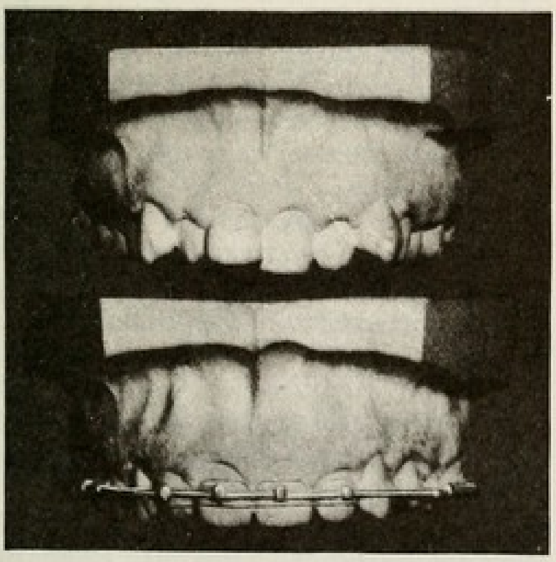


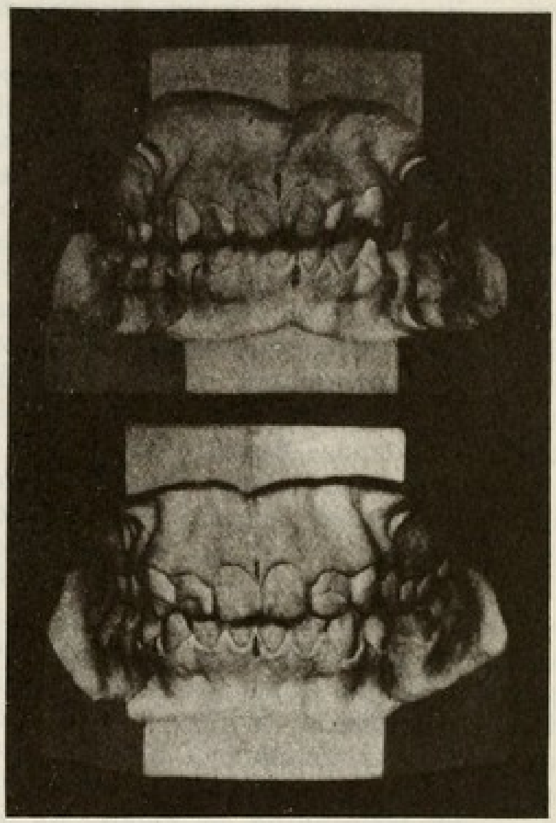
FIG. 30.



with the models of the cases, and who will doubtless later make a more extended report of them in the literature.

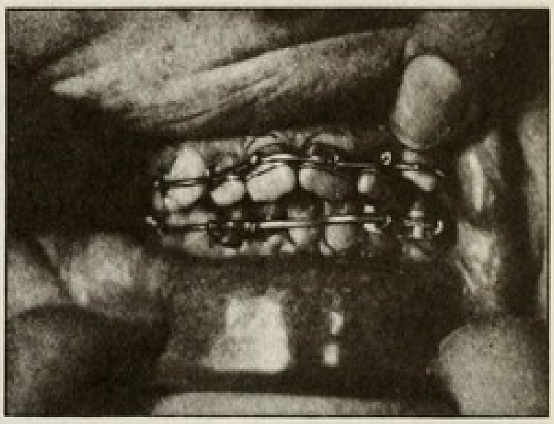
The occlusion of the second case, before treatment, is shown in Fig. 28, and

FIGS. 31 AND 32.



the model of the upper arch, after treatment, in Fig. 29. The model of the

FIG. 33.



lower arch after treatment is not shown, as it was corrected with the pin and tube appliance. Although the tooth movements gained are comparatively simple, yet the work has been beautifully done. By comparing the positions of the roots of the teeth in the two models indicated in Fig. 30, those of the laterals, especially, are clearly shown to have been moved.

The next case, Fig. 31, was treated with this mechanism by Dr. A. H. Ketcham of Denver, the third case to be so treated. Fig. 33 shows the teeth with the appliances in position upon them, and in Fig. 32 you will see the very gratifying changes in the positions of the teeth that were accomplished. Dr. Ketcham is present with a full series of models of this case. He will explain them to you, and later will probably make an extended report of the case.

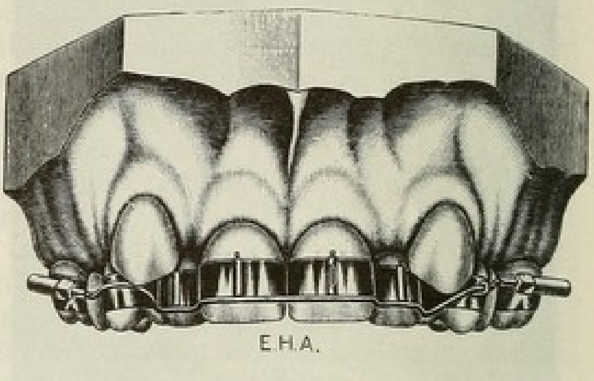
Still other cases have been more recently treated by Dr. F. A. Gough of Brooklyn, and Dr. R. H. W. Strang of Bridgeport, Conn. These gentlemen will explain the models of their cases this afternoon, at which time we will also begin our clinic in which you will all adjust the new appliances to models, in accordance with the technique I have just described, in order that there may later be no misunderstanding in regard to the technique, nor blunders in the use of the mechanism in your practices.

CRITIQUE OF PERPENDICULAR LOOP VS. PIN AND TUBE APPLIANCE.

In comparison with the screw as a means of applying force from a base of anchorage in orthodontic treatment I now wish to consider, in a spirit of friendly criticism, a very different mechanical principle for this purpose which has recently been advocated by Drs. Robinson and Young, especially in connection with my pin and tube appliance, Fig. 34.

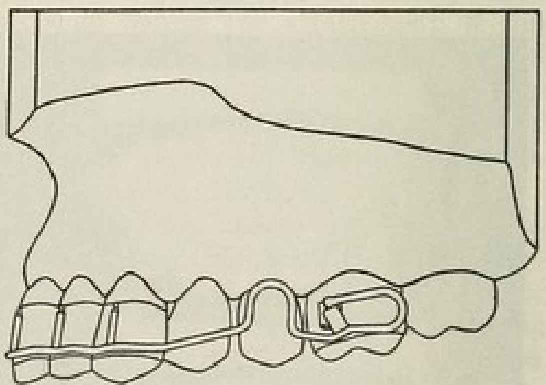
The plan is to exert force by means of the elasticity of a perpendicular loop, or loops, formed in the arch, as in Fig. 35, instead of by a screw. This loop is temporarily contracted, and is engaged, by its square or elliptical perpendicular attachment, within a closely fitting segment of tubing soldered vertically to the anchor band, its accidental displacement being prevented by a lock-end projection in the form of a second loop which engages the lower end of the tube. The force from the first loop must continue until the elasticity is exhausted by the movement of those teeth that are attached to the arch anteriorly, or of the anchor teeth, or both. Then the arch

FIG. 34.



is disengaged from the perpendicular tube, the loop is slightly straightened, again temporarily contracted, and the arch once more sprung into position. This modification of the form of the loop is periodically repeated until the loop disappears, more or less, through the straightening of the bar of metal.

FIG. 35.



My criticism is that instead of the force being delivered evenly to the anchor tooth and *in one direction only,* as is easily possible with the screw (Fig. 14), the direction of force is constantly changed, thus mischievously disturbing the function of the cells of the peridental membrane and alveolar process. And this must be repeated with each change in the form of the loop. The disturbance is also further aggravated by the frequent removal and replacement of the mechanism necessary in its operation. This continual pushing and pulling of the tooth backward and forward in its socket is in direct violation of the physiology of cell function, and must inevitably cause irritation, pain, and absorption of tissue. Such injurious disturbance of the tissues, which has always been more or less unavoidable when faulty mechanism has been used, has been the chief cause of soreness and pain in orthodontic treatment. It is no wonder that the anchorage becomes loosened. Neither is it strange that, when a loop is formed farther forward, as in the region of the canine teeth (see Fig. 36), excessive absorption occurs in the region of the incisor roots. The effect is the same as on the anchor teeth—constant change in the direction of force, with the inevitable disturbance of the cells of the alveolar process, from the backward and forward displacement of the roots of the incisors. I have had the privilege of examining a number of cases treated by means of these loops by other orthodontists in which this result is evident.

On the one hand, with the screw, we have a process in full accord with physiological principles, under complete and instant control of both operator and patient by the simple turning of the nut, with power of exactly the desired amount applied steadily in one direction. Moreover, we have a mechanism with the minimum amount of material, and with the least interference with occlusion and inconvenience to the patient.

Fig. 36.

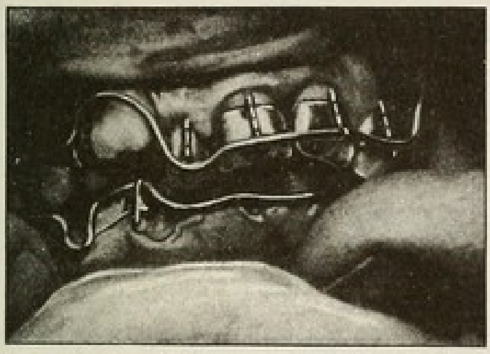
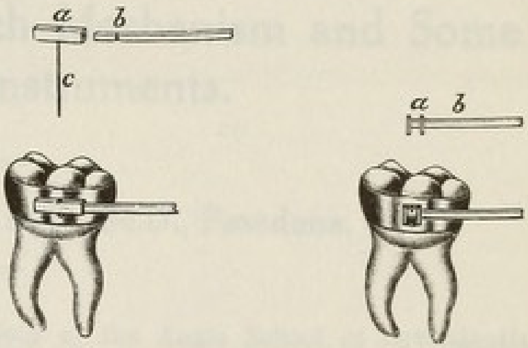


Fig. 37.



On the other hand, in the use of the loop there is unnecessary disturbance of cell function, often serious, necessarily frequent change in the appliance which only the operator can make, and also an entirely inadequate knowledge of the amount and direction of power applied, while the loop itself offers more interference with occlusion, is unstable, unsanitary, bulky, and inconvenient to the wearer, besides being most inartistic.

Equally or even more ridiculous is the use of the loop in combination with the screw, as advocated by some writers, for the same evil effect is present, with increase of material, and without the least need for its use. Those who use a loop in connection with the screw seem to forget that the entire expansion arch is a loop and must continue to exert force both statically and dynamically as long as there is tension on any part of it.

Now, if wrongful disturbance of the tissues is the result of power gained from the perpendicular loop, the question will naturally be asked by some of you, Why will not the same results follow the straightening of the small horizontal bends in the arch in order to give it true arch form and carry the teeth labially, as in Fig. 34? The answer is very simple: The force given to the teeth in this way is in the right direction for their bodily labial movement, for as the bends are occasionally slightly straightened, both the dental arch and the expansion arch are gradually and evenly enlarged. Force is thus not only under proper control, but it is exerted only in the direction necessary for the proper enlargement of the dental arch, and not in conflicting or disturbing directions.

While there could be no objection to this form of locking mechanism for the passive support of the end of the arch in retention, and independent of all perpendicular loops, yet I am not very proud of its use even here, and I now use in preference any of the locking mechanisms shown in Fig. 37, any of which are decidedly more simple, cleanly, and certainly as efficient as the Angle-Young lock. I regard this mechanism as now obsolete.

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ORIGINAL COMMUNICATIONS

Orthodontia—The Ribbon-Arch Mechanism and Some New Auxiliary Instruments.

By EDWARD H. ANGLE, D.D.S., M.D., Sc.D., Pasadena, Calif.

(Read at the annual meeting of the Alumni Society of the Angle School of Orthodontia, Pasadena, Calif., August 7, 1917.)

AT our last meeting one year ago, at New London, Conn., I introduced the new ribbon-arch-bracket mechanism, a description of which was published in the DENTAL COSMOS for September 1916, and which I hope each one of you has read at least once a month ever since, that you may the better understand the principles advocated therein and better comprehend what I shall present today. Naturally I am greatly pleased with the widely favorable reception that has been accorded this mechanism, but especially am I pleased to know of the fine success that many of you, my former students, report in its use in your own practices.

Today I wish to continue our work of last year in further elaborating upon this mechanism in treatment and in indicating how the principle may be advantageously extended to apply in retention. I wish, also, to present other orthodontic inventions and ideas which are for the most part designed to assist directly or indirectly in the employment of this mechanism, all of which will, I believe, make the work of orthodontists easier and more certain and satisfactory.

But before going on with these subjects there is another matter I wish to discuss which I believe to be of far more importance to you now than any kind of mechanism, new or old. It is the vital matter of *principles*—those principles which not only underlie orthodontia as a whole, but which are behind each step in each orthodontic operation.

Now these principles are not the vague, indefinite and intangible shadows that the work of many orthodontists would indicate they are understood to be, but they are so simple, so plain and so tangible as, when really understood, to become the natural guide and working basis for all orthodontic efforts.

And just in proportion to his grasp of the underlying principles is the work of the orthodontist reduced from chaos to order and system; from mere guesswork as to the outcome of mechanism adjusted and force applied, to the scientific knowledge of what definite results will follow given definite causes, and with corresponding ease and satisfaction in his work. You may be certain that your progress and your success in orthodontia will ever be gaged by your comprehension of its underlying principles and the degree of your conformity to them. And this applies with equal force to all phases of your work, from diagnosis to the adjustment of a ligature, the locking or unlocking of a pin or other attachment, the making and cementing of bands, the adjusting of clamp bands, the tempering and shaping of expansion arches, the controlling, both in degree and direction, of the force from the orthodontic mechanism, etc., and not less to judging of the merits and demerits of orthodontic mechanism, whether new or old. Many permit others to make this decision for them, but this is a sad commentary on their own grasp of principles.

As I pointed out at our last meeting (and as has since been echoed by others), these principles are the simple principles of dynamics, physiology and art as related to orthodontia, in which relationship the laws that govern these subjects are found, when understood, to be not antagonistic but in perfect accord, perfect harmony. For example, when a band is of proper width and thickness and placed in proper location on a tooth, it will be most efficient, most graceful and pleasing in appearance, and in nearest accord with the functions of the tissues directly and indirectly related to the tooth, hence will best conform to the principles above enumerated. Whereas, when it is of improper width or thickness and improperly positioned upon the tooth, with a clumsily brazed seam in evidence, and weakened by the removal of generous portions in festooning it mesially and distally, it cannot properly conform to these principles.

Again, a correctly proportioned expansion arch of proper material, bent to exert the required force in the required directions, with firm, accurate and properly proportioned attachments will not be unpleasing in appearance, will offer but the slightest interference with the functions of the mouth, will operate with the greatest efficiency and in accordance with physiological cell stimulation; therefore it will conform to the orthodontically related laws of art, dynamics and physiology. On the other hand, ill-proportioned, badly-fitting and wrongly placed mechanism not only fails to conform to the requirements of art and dynamics, but, in like proportion, to the laws of physiology, for the reason that it is not only unsightly in appearance and unreliable in the control of force, but must necessarily disturb or even injure the tissues directly and indirectly involved.

Obviously, then, in proportion as orthodontic mechanism as a whole or in any of its parts fails to conform to the principles enumerated, it is defective and unscientific.

My friends, I wish you would think seriously of these things, for, as I have said, the efficiency of the orthodontist and his value as a scientist is in exact proportion to his comprehension of the laws that govern his operations and his technical skill in the use of the best orthodontic mechanism. There are many men practicing orthodontia today who have thus far failed to grasp this fundamental truth. Often I have stood by the chairs of orthodontists and seen their work, and I have seen work from the hands of many others, also I am familiar with the writings of orthodontists and I know whereof I speak. All too often their technique in the assembling and adjusting of the mechanism they employ is most crude, careless and unskilful. The degree of force they exert on the teeth and the directions in which it is exerted are frequently but matters of conjecture with them, determined only by "watchful waiting," and resulting not only in the more or less haphazard movement of teeth, but often—and what is far more serious—in the positive injury of the alveolar tissues, as attested by a large number of skiagraphs I have collected which verify this statement and which I would ask each of you to study carefully in our clinic.

And this is not all. Instead of keeping the condition of each case well in hand and at every visit of each patient doing then and there all that is indicated to be done at that time (and no more), so that the work may progress to completion with physiological rapidity, patients come week after week and month after month and all too often are dismissed with "a lick and a promise," until finally the period of treatment, which might easily have been limited to weeks or months, lengthens out into years—two years, three years, five years, seven, even eight years, and still the work is unfinished. No wonder such orthodontists are "busy." No wonder that patients and parents become discouraged. No wonder that capable dentists, whose opinions we may well consider, criticize orthodontia, nor that our important work so often receives blighting censure from the teachers of our patients and others of the laity. The practice of unnecessarily burdening children with unsightly orthodontic mechanism during the most important formative period of their lives, say from the ages of four to twelve and even fifteen years, as many orthodontists are doing, is little short of criminal.

To my criticisms of the inordinately long time consumed in treatment there always comes the reply, "I don't believe in too rapid movement of teeth." Neither do I, but I do believe that nature has established a very reliable rate of speed for tooth movement, namely, the progress of teeth in eruption, and while it may not always be advisable for us to equal this speed, it seems equally inadvisable to diminish it from ten to twenty times, and to do so is to carry this "I do not believe" very far onto indefensible ground.

I have also seen numerous cases of needless interference with nature in her efforts to erupt the teeth and develop the alveolar process and even some in which the appliances were actually handicapping normal growth and development. I am inclined to think there are many such cases, and they must to a large extent be due to a lack of fundamental knowledge on the part of the orthodontist of the normal forces of growth and development. Also, I have noted numerous other instances where treatment had long been in progress to overcome malocclusion which had clearly been caused by pernicious habits of lip or tongue, and although the habits were still clearly in evidence, both orthodontists and patients were entirely oblivious to their existence.

I think it will yet be found that there is another most unfortunate result of unnecessarily long-continued hampering of the normal freedom of individual teeth, namely, that it is the exciting cause of greater or less absorption of their roots. Further facts to substantiate this belief, however, are necessary.

Now I do not say all these things in a spirit of fault-finding, but I say them in the earnest hope of arousing you to a sense of your responsibilities, and in an effort to stimulate you to develop greater skill in your technique and to gain a clearer comprehension of the principles which underlie your daily and hourly work, without which new appliances, no matter how faultless in principle or in construction, could add little to your efficiency.

The trouble seems largely to be that many orthodontists see only details, *things,* and these vaguely; not the subject in its entirety with the principles that underlie it and that, as I have said, underlie each smallest step in each operation. The "pointer getter" is an example. You know that in his methods of practice he is as changeable as a weathercock and never attains much proficiency. And I believe that the reason so many are misled by the false and often ridiculous teachings that are all too common in orthodontia is because they do not reason from *principles.*

Another thought. Our daily work is largely the repetition of a series of simple mechanical operations such as making and cementing bands, modifying the forms of expansion arches, locking and unlocking the various forms of attachment, etc. And because there are not many best ways, but *only one best way* to do each of these things, this should become the standard way and its continued repetition should lead to the greatest proficiency on the part of each orthodontist. Also, what is extemely important, the motions necessary to the performance of each step in each operation would thus be reduced to the fewest possible number, with a corresponding conservation of time of both patient and operator. I want you to think of this, for I know it is not impracticable, but on the contrary very practicable and in keeping with the spirit of the great efficiency movement that has come to be recognized as of practical advantage in all phases of human endeavor, even, at last, in specific branches of modern surgery.

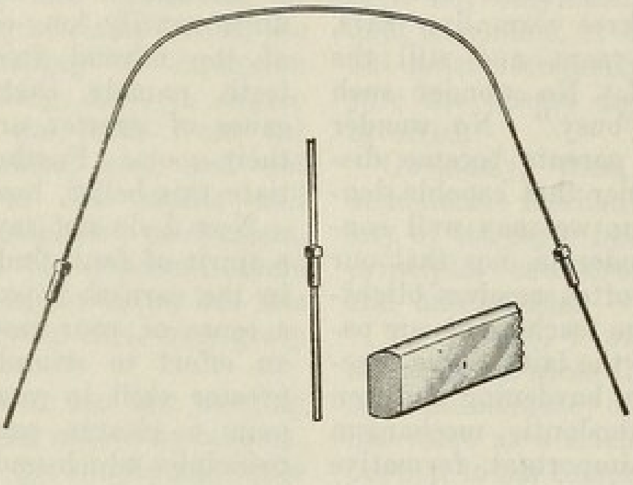
RIBBON-ARCH MECHANISM.

Let us now hastily review the ribbon-arch mechanism as I gave it last year, and see if, with our combined experience in its use since then, we find any changes to be desirable either in the appliances themselves or in the methods advocated for operating them.

I have had ample opportunity for conducting further practical tests with them in continuing the treatment of a number of patients left by one of our own valued members, Dr. Wellslake D. Morse, who died at his home here in Pasadena in February last. In these cases nearly all phases of treatment have been encountered, and I am further confirmed in my belief that with these appliances it is more easily possible to conduct treatment, and that in closer accord with the physiological demands of the tissues, especially of the alveolar structures, than with any we have previously employed.

You will remember that both long and short ribbon arches which I described to you were .022″ thick by .036″ wide (Fig. 1), and that it seemed to some of you at that time that an arch so delicate might not afford sufficient power to meet all demands, especially for widening and narrowing dental arches. In the severe tests of this kind to which I have subjected it I have found no need for a heavier arch and I have accomplished both operations more easily with it than I ever did with heavier arches. This, I think, is explained in the fact that the ribbon arch acts so evenly and continuously; that the stimulation of the cells, in its use, is so nearly physiological. I am sure if you have not succeeded in widening or narrowing dental arches with it it was for the reason that in finally placing the arch in position upon the teeth you accidentally bent it in such a way as to reduce its power—something that

Fig. 1.

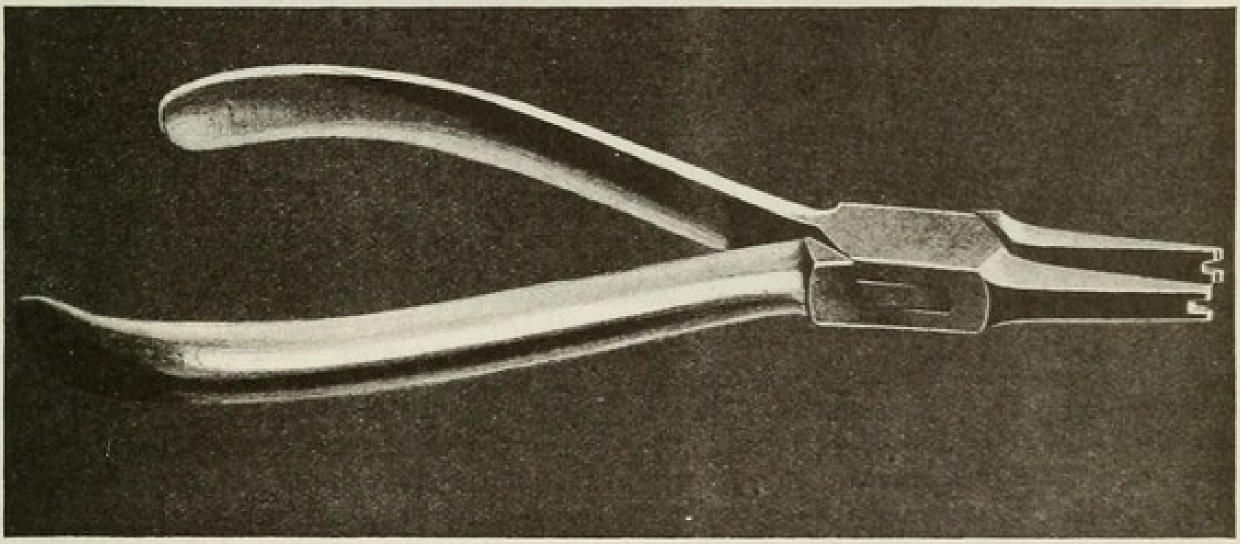


may easily happen unless you are very careful and painstaking in adjusting it —or, that you failed to take advantage of another force which I wish here to emphasize, for I fear it is not clear to some of you, namely, the twist or torque of those portions of the arch that lie within the curvilinear sheaths. I think this latter force is quite as powerful as the usual simple expansive or contractive force of the arch, and if you fail to enlist it by not giving the ends of the arch the proper twists before inserting them in the sheaths, so that they will bind for a tilting outward or inward movement of the crowns of the anchor teeth when this is needed you are sacrificing much possible efficiency in the use of the ribbon arch. Of course the power to be gained from the torque in the arch applies equally to the relation of the arch with the brackets as to its relation with the sheaths.

You must think and reason carefully on these problems in dynamics, for on them your efficiency and success depend so largely. I have been greatly surprised to find, on examining some of your cases during treatment, that where the arch was properly adjusted to give the desired lateral movement outward, the torque within the sheaths was exerting force for the opposite or lingual movement of the anchor teeth. Thus the two forces conflicted and to a certain extent neutralized each other. Again, I say, think of these points and weigh all your mechanical problems carefully. Be master of them and leave nothing to chance.

I have also found that for all other movements of teeth, both of roots and crowns—and the experience of most of you coincides with mine in this—the power is abundant and the tooth movements have been prompt and satisfactory. The reason is of course apparent: the great range of elasticity in the arch, coupled with the very ideal attachment of the teeth to the arch, which firmly controls their movement, but which at the same time permits them desirable freedom. Moreover, I believe when all the power in the arch is enlisted it is not so great as to cause the teeth to move more rapidly than with physiological speed, as I have found no instance in which this seems to have occurred as evinced by soreness, pain, etc. My general rule is to enlist the full power of the arch, provided, of course, cell and capillary function is not to be unnecessarily interfered with through the too frequent readjustment of the appliance. Of course this rule might sometimes need to be modified. The trouble, however, will not be that the teeth will move too fast, but that they may, without

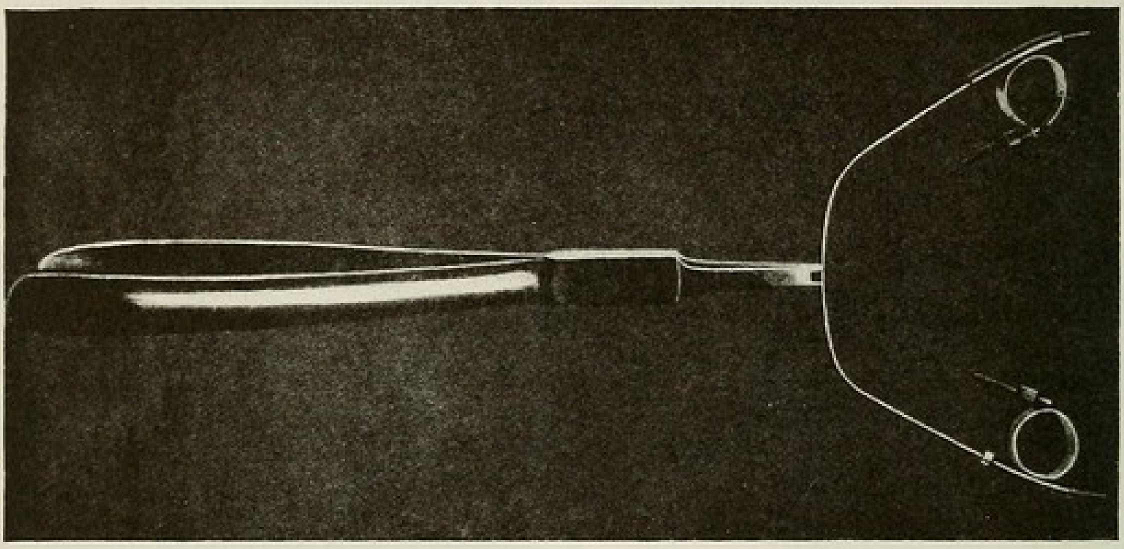
Fig. 2.



proper supervision, move too far. Instead of a heavier arch being desirable I think one even more delicate may, for reasons which I shall point out later, be more advantageous in certain cases.

Some of you have broken these delicate arches. I, also, have broken two of them, but in my case the fault was clearly my own. It ought not to be necessary to remind men who are working with precious metals, as you are doing, that the metals occasionally require to be *evenly* annealed, especially if they are subjected to considerable molecular disturbance, as in the pronounced bending and subsequent straightening often required in the ribbon arch. Also it is well to remember that we are undergoing a radical change from heavy to delicate mechanism and that it is imperative for us to develop delicacy of touch and manipulation. A blacksmith would have to re-educate his fingers if he were to become a successful watch repairer.

Fig. 3.

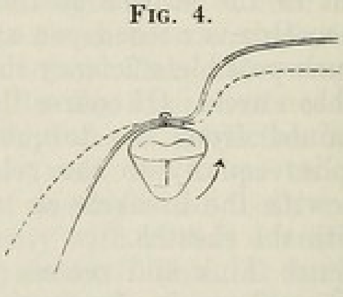


RIBBON-ARCH SEATING PLIERS.

Although I still believe the safest way to seat the arch is, in most instances, by means of skilful fingers, occasionally assisted by a piece of orangewood or bone, yet for gaining the necessary lateral twist in the arch to effect rotation, or forming the decided bend for engaging a bracket on a tooth that is in pronounced lingual occlusion, as in Fig. 10, the special pair of pliers which I have recently devised (shown in Fig. 2), will be found of great assistance, particularly in the first application of the arch.

It will be noted that the beaks of these pliers are bifurcated, thus forming a pair of minute jaws on each beak. All four of the jaws are of the same dimensions. The bifurcating slots are slightly larger than the width and depth of the bracket and permit the two pairs of jaws to operate one on each side of the bracket. A delicate groove traverses the inner surface of each of the four jaws close to the end of each. When the jaws are closed on the two sides of a ribbon arch the arch is evenly and firmly held in these grooves, as shown in Fig. 3. Now by firmly grasping the handles of the pliers the arch may be twisted and

Fig. 4.



seated in the bracket, as in Fig. 4, or sprung and bent as it is carried lingually and seated in the bracket, as in Fig. 10, without any undue strain on the bracket. In seating the arch as in Fig. 10 its two ends are first engaged in the curvilinear sheaths, the nuts having been turned well forward so that they will in no way interfere with the bending of the arch as it is brought into bracket relations by means of the pliers. Not until the arch has been seated in the brackets should the nuts be moved to their proper tension relations with the anchor sheaths. I am sure you will derive much satisfaction from the use of these pliers.

LOCK PINS.

The original dimensions of the main shaft of the lock pins were .010″ by .010″. In experience pins of these dimensions proved too small, in some cases, to afford the necessary locking strength. As now made they are .010″ by .010″ near their points, gradually increasing in diameter antero-posteriorly to .014″ at the beginning of their heads, this additional width making them amply strong.

Now let me here interpolate a word with regard to measurements. Those of you who still persist in employing the much out of date "gage" should change your system of measurement and learn to think in thousandths of an inch through owning and employing a small micrometer which is far more accurate, definite, scientific and up to date.

The pins are made of a fine quality of brass. Some of you have requested that they also be made of pure gold or of some alloy of precious metals. I have no doubt the manufacturers will be glad to supply them to you in precious metal. For my own needs, however, I much prefer them of brass, as I have been unable to find any precious metal alloy that equals brass in toughness and strength, though I early experimented quite extensively with alloys. Although in their immediate region brass pins may cause slight discoloration of the ribbon arch, if the patient does not give regular and proper attention to oral cleanliness, yet the proper cleansing of the teeth by the patient being easily possible when this mechanism is used, there should be no real objection to the use of brass pins.

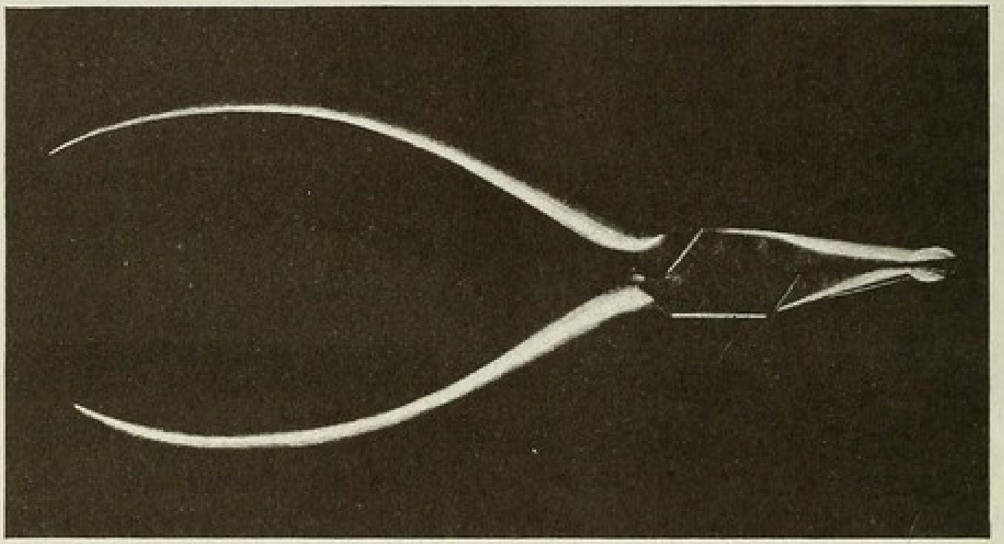
And here let me interpolate another word. All agree that the teeth should be kept properly cleansed during orthodontic treatment and much has been said and written on the subject. Many orthodontists devote much time at each appointment of their patients to the spraying and cleansing of the patient's teeth, and strongly advocate this procedure. Now I radically disapprove of it, or the transference to the orthodontist of the work which rightfully belongs to the patient. It is the orthodontist's duty to place only such mechanism upon the teeth as will not interfere with their regular, systematic brushing and cleansing by the patient at least twice a day, and then he should insist on the patient's doing it, for the time and effort of the orthodontist should be more advantageously employed. If a patient does not keep his teeth clean and the orthodontic mechanism bright, it is clear that he is lax in his duties and should be disciplined.

At our last meeting I recommended that in order to clinch the pins in the brackets they should be bent forward and upward. Experience has proved, however, that they are more in the way of the lips of the patient and that it is more difficult to straighten them for their removal when so bent than when they are bent to one side. The point of the pin is grasped with a pair of close-fitting pliers (the flat beaks of the arch-bending pliers serve admirably for this purpose) and drawn through the bracket until its head rests firmly against the ribbon arch which has already been fully seated within the bracket. With full tension still maintained the pin is now drawn sharply at right angles to the bracket (as in A, Fig. 30), thus giving it a sharp bend and firm clinch. Now, without in the least disturbing the bend, the pin should be clipped off *close* to the side of the bracket (as in B, Fig. 30), leaving no projection and requiring no burnishing which would only endanger the bend. In order to save time in locating the bend for the removal of the pin we, here in the West, have agreed to always make it toward the left of the bracket.

PINCUTTERS.

I have found it impossible to cut the pin close to the side of the bracket with scissors without disturbing the bend, so for this purpose I have devised the minute pincutters shown in Fig. 5, which "do the trick" perfectly. They will also be found much better than scissors for clipping off the superfluous portions of wire ligatures.

Fig. 5.

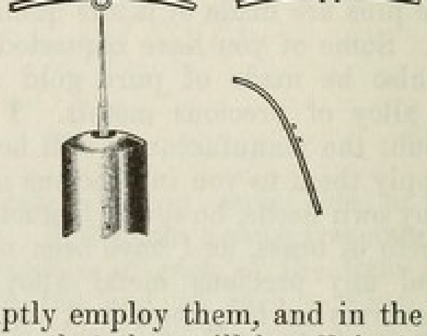


CLEATS.

The little cleats, shown in Fig. 6, have been improved by stamping them from much thicker material than that of which they were at first made, in order to give them greater strength. I am disappointed that many of you are not making as much use of the cleats as you should, for their occasional, if not frequent, use is absolutely necessary to successful practice with this mechanism in such cases (quite numerous) as those I pointed out last year, one of which is illustrated in Figs. 7 and 8. In this case, in addition to the distal movement of the upper molars and bicuspids to make room for the unerupted cuspid, the labial movement of the roots of all the incisors and the bodily movement of one of the laterals in a mesial direction was necessary, the latter having been accomplished, as shown in Fig. 8, through the influence of the cleats attached to the arch.

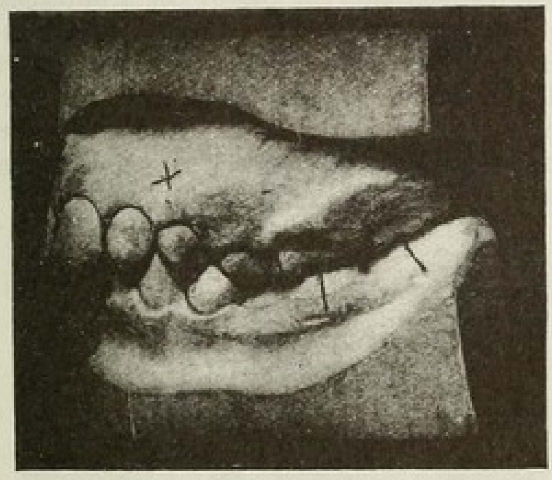
I cannot too strongly recommend you to master the very simple operation of properly locating and soldering these cleats, so that when their use is indicated you will not procrastinate, but promptly employ them, and in the right way, so that they will be efficient. And here is a little improvement in the technique of the operation of soldering the cleats over that which I gave you last year. A very minute piece of solder, not

Fig. 6.



more than .004″ in any dimension, is placed on each arm of a cleat and the cleat supported on a straight piece of thin platinum plate in the flame until the solder is fused. The solder-side of the cleat is now placed in contact with the arch at the previously indicated de-

FIG. 7.

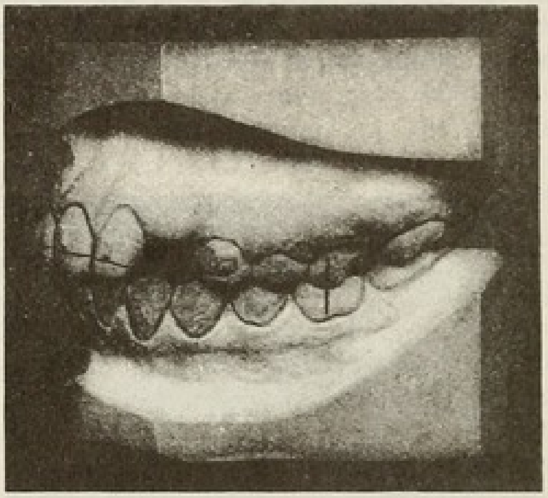


sired point, and the solder again fused, uniting the cleat to the arch. For this the flame of a small spirit lamp is used in preference to the more concentrated and intense flame of the blowpipe, the heat being thus more slowly and evenly raised to the fusing point of the solder, with consequent less danger of overheating the arch. No additional borax is required for the second fusing, provided the arch is clean.

It is well to flow the solder on the cleats during some leisure hour, thus having a supply of them in readiness for use when needed.

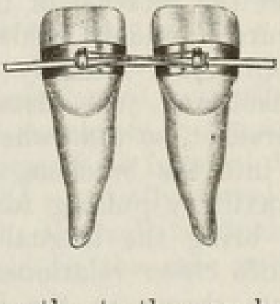
A method of closing space between central incisors which I gave you last year is to use a wire ligature as illustrated in Fig. 9. One of our number, Dr. W. C. Smith, has suggested another way to accomplish this which I think in the hands of many would be better. The ligature is dispensed with and two delicate spurs are soldered to the outer surface of the ribbon arch close to the distal surfaces of the brackets on the bands on the centrals. Now by occasionally moving one of these spurs slightly mesially, say ten or fifteen thousandths of an inch, and again springing the arch into the brackets, the desired movements of the teeth will be effectually accomplished. The spurs should be very small. I think they may best be made in the form of delicate cubes of platinum

FIG. 8.



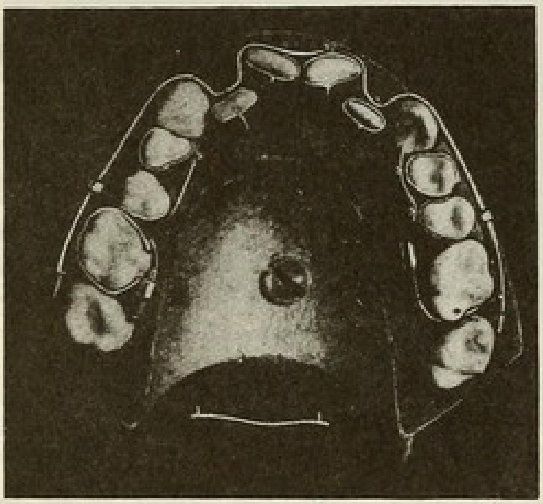
not more than .015″ in any dimension. They are most easily and safely moved by teasing them forward with the point of a needle while the solder is in the molten state, the arch being held in the flame of an alcohol lamp.

FIG. 9.



Of course the teeth may be moved in the opposite directions by reversing the relations of the spurs with the brackets. By the same means the position of the crown of any individual tooth may be changed. And here is an idea which may be made useful for the double rotation of teeth, independent of the ribbon arch. The mechanism is shown in position on the bicuspids on both right and left sides of the dental arch in Fig. 10. Sections of the ribbon arch are sprung into brackets on the lingual surfaces of the teeth, the force so exerted acting reciprocally between the teeth for their rotation. Of course these segments would need to be removed occasionally, and unbent or otherwise re-formed to properly exert force, and re-seated in the brackets. The bend in the wire on the left should be made at a point midway between the two bracket attachments, as shown in the illustration just

Fig. 10.



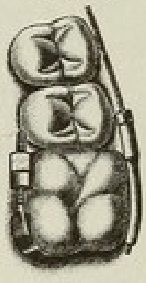
beneath the larger engraving, Fig. 10. To give additional force in the direction required for the rotation of these teeth, delicate spurs should be soldered to the arch at points just mesially to the anterior bracket and just distally to the posterior bracket, so that when the wire is sprung into the brackets, after it is bent, an auxiliary pulling force will be exerted to bring the lingual angles of the teeth into closer relations.

The spurs shown in the illustration are much longer than should be employed. They were intentionally so made in order that they might be better shown by the camera.

CURVILINEAR SHEATHS.

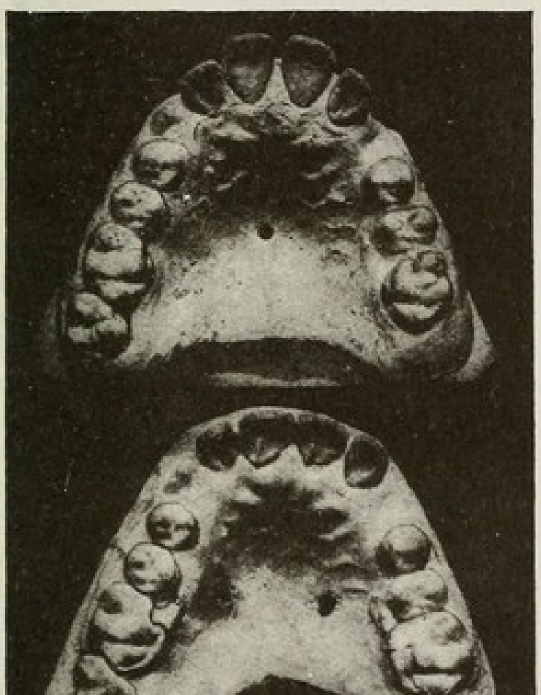
Now a few words in regard to the mechanical principle involved in the use of the arch within the delicate new curvilinear sheaths of the anchor bands (Fig. 11). Much to my disappointment some of you, I find, do not seem to fully comprehend the principle or realize all of its advantages. All of you know how prone any arch is to work forward in straight sheaths, this being in accordance with the law that motion follows the line of least resistance, as in the displacement of the handle of a hammer, or the loosening of the ferrule of a cane or umbrella, etc. Of course the forward displacement of the arch and the friction sleeves of the nuts, caused by jarring incident to occlusion, mastication, etc., is only another illustration.

Fig. 11.



Now a great advantage in the use of the curvilinear sheath which seems not to be clear to many of you is that with it it is not only easily possible to wholly prevent the working forward of the arch and to keep the friction nuts firmly seated within their attachments, but also that the arch, without auxiliary attachments, may be caused to work distally within such sheaths when this is desired, even to exerting considerable force for the retraction of prominent incisors. (Of course in such cases the nuts are turned well forward, as on the lower model (a study model) in Fig. 12.) This crawling movement in a distal direction is brought about by very evenly bending those portions of the arch that are to lie within the sheaths to arcs of smaller circles than those to which the sheaths are bent. Now, when the ends of the arch are placed in the sheaths they are on tension through the conforming of the smaller curves of the ends of the arch to the larger curves of the sheaths, and the tension so exerted tends to work the arch distally or along the line of least resistance. In other words, the ends of the arch so bent act as spring hooks within the sheaths to pull the arch distally. But if you will persist in forcing the straight arch within curved sheaths and not first amply curve its ends, the result will be the same as when a straight arch and straight sheaths are employed, namely, the arch will tend to work forward, only in the former case

Fig. 12.



this tendency will be more pronounced than in the latter, due to the effort of the metal within the sheaths (which is on tension opposite to that secured when the ends of the arch are properly curved) to gain equilibrium along the line of least resistance.

This ought to be clear to you and it ought also to make clear why there was distal displacement of the anchor teeth in one of the cases we saw in the clinic today. The reason was obvious. Force had been wrongly directed. The straight ends of the arch had been sprung within the curved sheaths, and the anterior part of the arch being firmly held in the brackets on several anterior teeth, the arch was prevented from working forward, so the anchor teeth were of necessity gradually pushed distally, simply as a result of the effort of the straight arch, sprung within the curved sheaths, to gain equilibrium along the line of least resistance. Had the ends of the arch, before they were seated, been bent to the arc of a smaller circle than that to which the sheaths were bent, the direction of force, as I have said, would have been reversed and there would have been no displacement of the anchor teeth. On the contrary they would have been held in their proper relations. Also the friction nuts would have been kept firmly seated within the sheaths and their accidental turning would have been impossible. It is well to remember, however, that we may on occasion take advantage of this possibility of moving anchor teeth distally, though it is better as a rule to depend for such movement on tightening the nuts in conjunction with intermaxillary ligatures, etc., as in this way the power may be more perfectly controlled.

There is also a further advantage to be had in the use of the curved sheath that some of you are not availing yourselves of, namely, to allow the ends of the arch to project well through the distal ends of the sheaths, at least in the beginning, instead of cutting them off close, thus not only giving a longer arch which may be useful later on as the dental arch is enlarged, but offering longer continued resistance to the natural tendency of the arch to forward displacement as its ends gradually travel forward in the sheaths through tightening the nuts than would be the case with a shorter arch.*

A still further advantage of the curved sheath which you all must appreciate is that it interferes far less than

* That the ends of the arch may be more easily slipped into the sheaths they should always be beveled and slightly coated with vaselin.

the straight sheath with the functions of the cheeks.

At our last meeting I carefully described the use of the ribbon arch in the treatment of a typical case belonging to Division 1, Class II, and told you how the retracting force within the curvilinear sheaths had been taken advantage of for the lingual movement of protruding upper incisors preliminary to the employment of intermaxillary force. As the illustrations were not ready for that meeting I could not show them, but I do so here that you may observe the possibilities of this source of power, new in orthodontia. It was tested in this case for the first time and in this instance attempted only as a test.

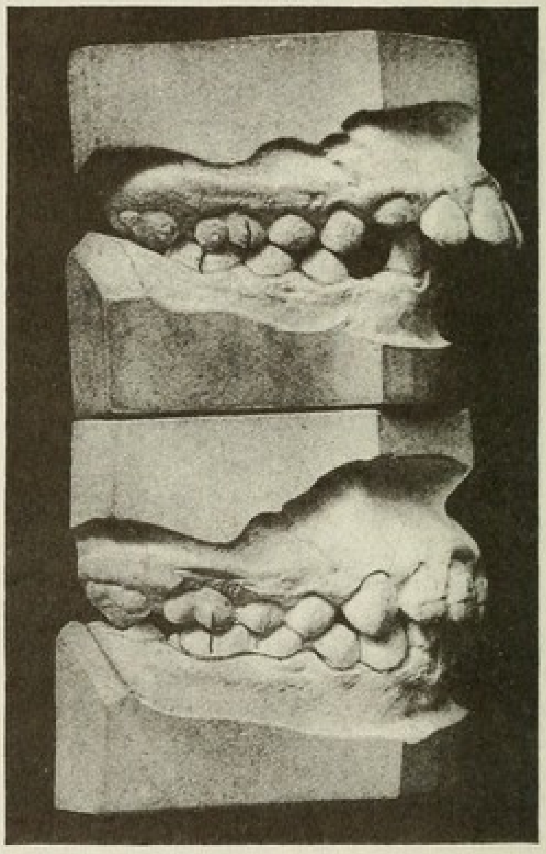
By comparing the positions of the teeth as shown by the two models in Fig. 12 you will see that considerable lingual movement of the crowns of the central incisors has taken place. This was accomplished wholly by the power from the spring of the ends of the arch within the curvilinear sheaths and within ten days of the application of the force, after which time hooks were attached to the upper ribbon arch opposite the cuspids and intermaxillary ligatures employed in the usual way.

The models at the beginning of treatment and at its completion are shown in Fig. 13.

DEPRESSING THE INCISORS AND ELEVATING THE MOLARS SIMULTANEOUSLY.

You will remember I stated that the active treatment of this case was embraced in a period of two months and that there were no unfavorable symptoms in the tissues. You will also remember that I described the manner in which the incisors were depressed simultaneously with the elevating of the molars, in this case, during the establishment of the normal mesio-distal relations of the teeth. This was done by aligning the sheaths on the anchor bands of both upper and lower first molars so that the ribbon arches, engaged passively therein, aligned at points on the gums about one-sixteenth of an inch apically from the gingiva. Now when the ribbon arches were carried occlusally and seated within the brackets there was, in consequence, force exerted for the distal tipping of the molars by the arch within the sheaths prying apically on the distal ends of the sheaths and occlusally on their mesial ends. Also, the force so exerted of course reacted in an apical direction on the incisors so that they were depressed to their proper height in

FIG. 13.



the line of occlusion, and the molars were elevated and tipped distally to their proper height and position in the line of occlusion, as shown in the lower model in Fig. 13.

I would ask you to study the pictures (Fig. 13) carefully, and you will see that these movements, always so desirable and heretofore so difficult, have been accomplished. I could easily have carried these movements still farther, even to the extent of causing "open bite." As I have since treated a number of similar cases with like satisfactory results, I repeat here that I feel sure there is no longer any occasion for prolonging the period of treatment in requiring our patients to wear "bite plates" or "cribs" in order to gain the proper heights of the planes of their teeth. While "bite plates" may doubtless often be employed to advantage in retention in order to relieve the force of mastication on molars that have been elevated, and to accentuate pressure on incisors that have been depressed in their sockets until the alveolar process and peridental membrane have attained their physiological structural reorganization, yet I am convinced that they are now much out of date for active treatment for the purpose of gaining the proper heights of teeth in the line of occlusion.

There is another point in connection with the treatment of this case, as well as of all similar cases, of much importance, and though I clearly called attention to it in the last edition of my book, yet it seems to have been entirely overlooked by all of you who have written or talked on the subject, namely, that the abnormal closure of the bite anteriorly is largely the result of the tipping of the molars, due to the axial stress being wrongly placed. Instead of the great weight of occlusion of the upper molars being received largely on the posterior half of the lower molars and the anterior half of the uppers, as it would be normally, it is in these cases transposed to the anterior half of the lower molars and the posterior half of the uppers, thus causing the lower molars to tip forward and downward, and allowing a closer closure of the jaws than normal. Treatment has reversed the axial stress so that there is now perfect equilibrium between teeth and alveolar process.

Perverted stress upon the molars resulting in the same condition of shortened bite is also shown in Fig. 7, a case belonging to Class I, where the jaws are in normal mesio-distal relation, but where the upper molars and premolars on the left side have moved forward following the premature loss of the temporary cuspids, assisted by improper functioning of the nose. Establishment of the normal axial stress relations of molars and premolars has here, also, resulted in lengthening the bite.

I wish here to again call your attention to another thought I made clear in the seventh edition of my book, but which I am sure has been wholly overlooked by many of you in the treatment of typical cases belonging to this division of Class II, namely, that logical treatment demands that force first be chiefly directed to the correction of the positions and relations of the first molars, closely followed by the movement, first, of the bicuspids and, finally, of the incisors and cuspids, for the reason that this was the order in which the malocclusion was established. It is therefore the logical and the easiest way to unravel the difficulties. I have seen many such cases in which the treatment was supposed to be completed, but in which this order of treatment had been reversed, or begun by reducing the prominence of the upper incisors—the mere symptoms of the real difficulty. Upon examining the relations of the upper with the lower molars in these supposedly finished cases I have often found them little better than in end-to-end bite. Failure is certain to follow if the molars are left in these relations. Therefore I would emphasize that *both upper and lower molars always be first tipped to their full upright positions,* and that their full normal mesiodistal relations also be gained through intermaxillary force, thus establishing the normal axial stress upon their crowns and roots and upon the associate tissues. This is absolutely essential to success in every case.

If you will carefully examine the relations of the molars in the case here shown you will see that this has been accomplished. You will note in the upper model in Fig. 13 that through the malocclusion of the first molars their axial stress has been perverted so that the crowns of both upper and lower are tipped forward and this tipping must continue and accentuate the mal-relations of all of the anterior teeth, as well as to continue the distal sliding movement of the mandible and still further shorten the bite.

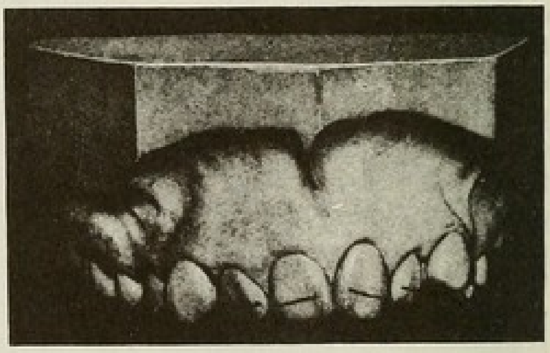
By examining the lower model you will see how the axial stress on the crowns and roots of both upper and lower molars has been restored to normal, simply as a result of tipping them upward and backward into their physiological axial stress and cusp relations, followed closely by the correct placing of the bicuspids, cuspids and incisors in their logical order, at the same time assisting the forward movement of the mandible through intermaxillary ligatures. You will also note that both upper and lower incisors have been depressed in their sockets until they are of proper height, and that the molars have been elevated.

I wish you would compare the models of the case shown in Figs. 12 and 13 with those of another case which Dr. Smith will show you, the original condition of the two cases having been almost identical. The latter case has been under treatment by a well-known orthodontist for more than three years, and nothing has yet been accomplished except that one of the upper first molars has been forced into most pronounced buccal occlusion. The reason for such a lamentable result is only partially explained by the appliances that were employed. These Dr. Smith has removed from the teeth of the patient and will show them in connection with the models of the case.

Several other models of cases from other orthodontists, which have recently come under my observation, the results of treatment of which are scarcely less deplorable, will also be shown, and these not only emphasize the necessity for a closer study of principles, but—and I think all thoughtful orthodontists and dentists will agree with me—for more just protection of the public through better legal regulations of the teaching and of the practice of orthodontia than now obtain.

I wish also to speak of another case, reported to me today by one of your number—a story that should be of much interest to you all. This gentleman referred a patient of his who was wearing the ribbon-arch mechanism to another well-known orthodontist in a distant city. The case belonged to Class I, an average case of a type commonly met with. After two months the patient returned home. Some changes for the better were noted and some for the worse. Upon removal of the ribbon-arches my informant said, "They curled up like watch springs," which occasioned him much surprise until the patient, upon being questioned, explained that where the bends in the arches had on several occasions been slightly straightened, this had been done without once removing the arches from their anchor connections. They had simply been lifted from the brackets, the bends pinched between flat-beaked pliers, and the arches again seated and locked within the brackets! It certainly is not new appliances that this man needs.

Fig. 14.



PLAIN BANDS.

Last year I described the positions that plain bands should occupy on anterior teeth in order that they might be most efficient and most artistic in appearance, and here is an idea that will assist you in more accurately positioning your bands. First, indicate by a lead pencil mark on the moist surface of the enamel of all the teeth to be banded the position that the incisal margin of each band should occupy, as shown in Fig. 14. Then it is easy to pinch and form the bands to conform to these lines, so that after the teeth have been gradually moved into conformity with the line of occlusion the bands, as well as the teeth, will assume harmony and balance of relation.

Fig. 15 A.

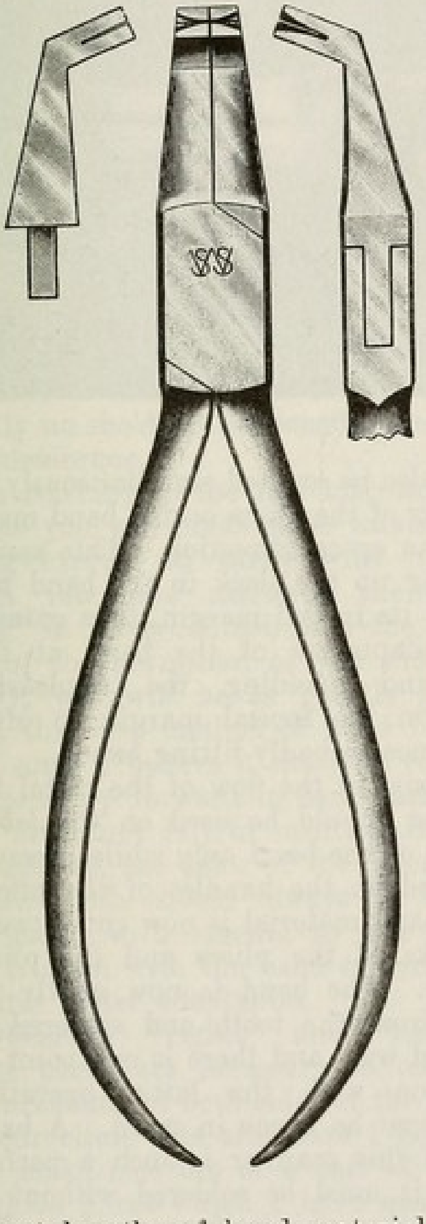
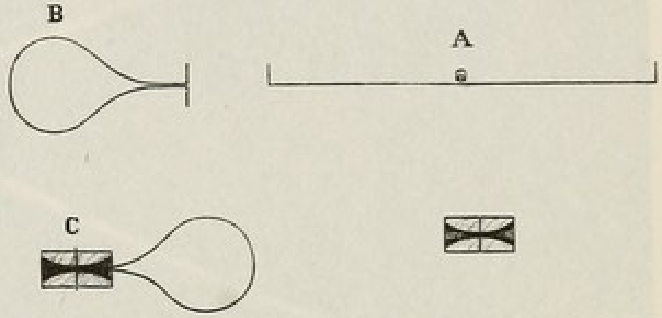


Fig. 15 B.



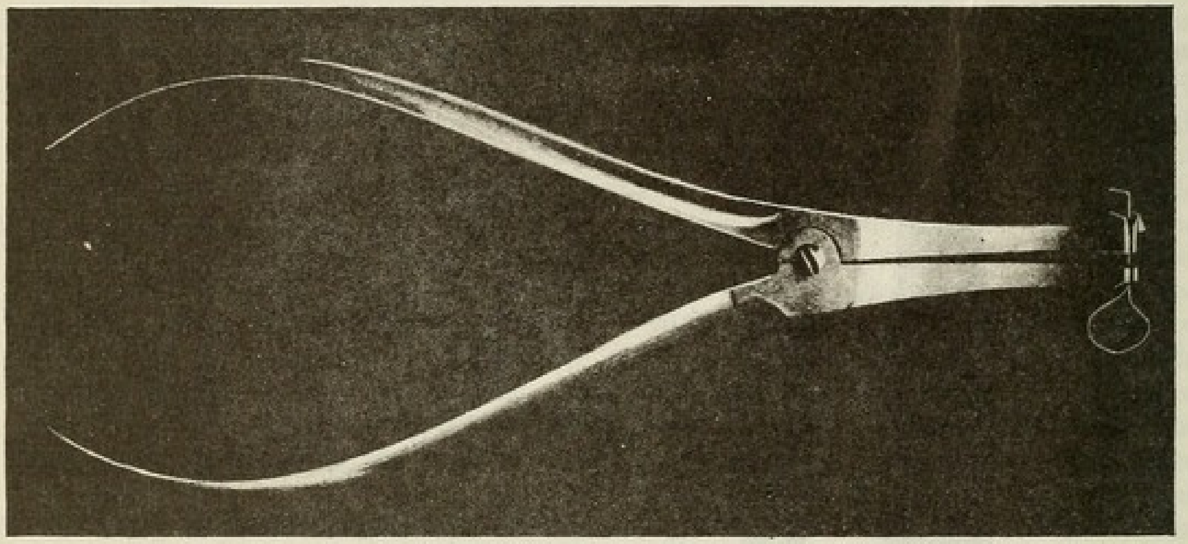
I showed you last year a new instrument, Fig. 15A, for holding the ends of short lengths of band material about a tooth while the band was being formed with the band-forming pliers. It is a very efficient instrument, but after perfecting it it occurred to me that it might be possible to do the entire operation, or both the holding and pinching, with one instrument, and if it could be made practicable the plan would be valuable, for it would greatly simplify this oft-required operation. I regret that I have not now time to show all of you (some of you have seen them) all the various models which marked the progressive steps in the development of this idea. It surely would interest you and it might also surprise some of you to learn what difficulties have to be overcome and what time and energy expended to bring to fruition any idea of this nature. And it would surely cause many to hesitate and to weigh their suggestions before offering them so promptly and so fatuously as "improvements" or "modifications," as they are so prone to do.

As usual the first models were very complicated, but after eight successive forms had been thoroughly considered, modified, simplified and discarded, the ninth developed into what I think you will find to be a very perfect and efficient instrument. It is shown in Fig. 16.

The beaks of these new band-forming pliers open by pressure on their handles. Near their ends the beaks are bent sharply at an angle of sixty-seven and a half degrees. A groove or slot passes transversely through both beaks, which in depth is a little greater than the width of the standard band material, and in width slightly greater than two thicknesses of standard band material. Passing obliquely through both jaws of one of the beaks is a clamp screw with a square head, which forms a miniature vise. The outer edge of the other beak is convex to conform to the lingual or concave surface of the incisors.

In use a piece of bracketed band material is bent in the form of a loop, its two ends seated in the transverse groove of the beaks, as shown in Fig. 16, and the band material thus tightly drawn about the tooth. In addition to gentle force for closing the handles, pressure

Fig. 16.



the screw firmly tightened by means of a key. The loop is then worked over the crown of the tooth to be banded,

Fig. 17.

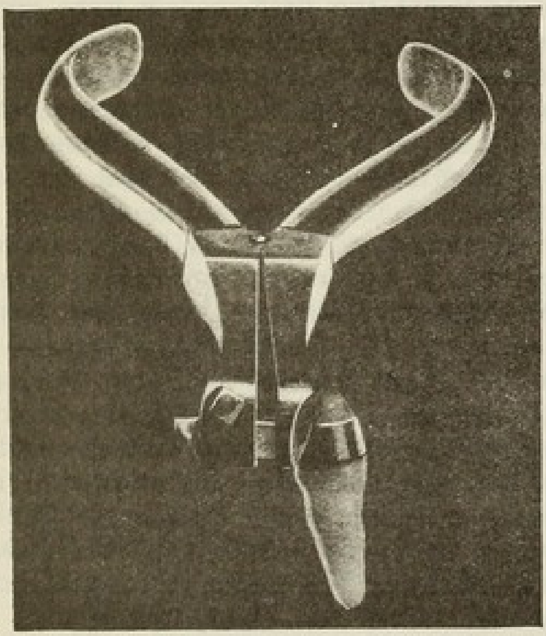


Fig. 17, to the position previously indicated by a pencil mark on the enamel. The handles are now pressed upon and should also be exerted simultaneously by the beaks of the pliers on the band material in an apical direction. This assists in taking up the slack in the band material at its incisal margin, thus gaining closer adaptation of the band at this point and avoiding the unpleasing crimps in the incisal margin so often in evidence in badly fitting bands.

To assist in the flow of the metal the burnisher should be used on the *labial margins* of the band *only* while pressure is exerted on the handles of the pliers.

The band material is now cut between the beaks of the pliers and the pliers removed. The band is now gently removed from the tooth and soldered in the usual way, and there is one point in connection with the latter operation which must be borne in mind. A band made in this manner is such a perfect fit that it must be soldered without in the least changing its form or size. For this reason it must be very lightly held by the band-soldering pliers while it is being soldered so that the two jaws of the unsoldered band will not be unduly pressed together, as this would diminish the size of the finished band and it would not go to place on the tooth.

After the band is fitted and soldered it is re-seated upon the tooth and burnished to close adaptation to the *lingual* curvature of the crown. It is then removed and further strengthened by flowing solder over its concave lingual surface, the soldered ends trimmed and smoothed, and the band polished and set in position on the tooth in cement. The result is a most beautiful and accurately fitting band.

If you will take time to master this method of band making you will find that your bands require very little cement and that they may be worked into their correct positions on the teeth more easily and satisfactorily than the bands you have heretofore made. They will also have greater efficiency and be more artistic in appearance. And the force exerted in forming the band is distributed so evenly that it occasions practically no shock to the sensitive peridental membrane.

In learning to use this instrument of course you will break some bands, force being exerted so easily with it. But when you have mastered the proper "feel" in force control, plus the proper use of the burnisher, as you should do easily, you will be as greatly pleased with this new method of band forming as I am. I believe it marks a very important step forward in band-making.

I must not fail to mention that the margins of the jaws of the pliers next to the tooth should always be slightly lubricated with vaselin, as this lessens the friction with the band material and insures better adaptation.

Obviously "rights" and "lefts" of these pliers are necessary to meet the requirements of both sides of the mouth. In our clinic this afternoon I hope you will make free use of a pair of models of these pliers which I have made.

ANCHOR BANDS.

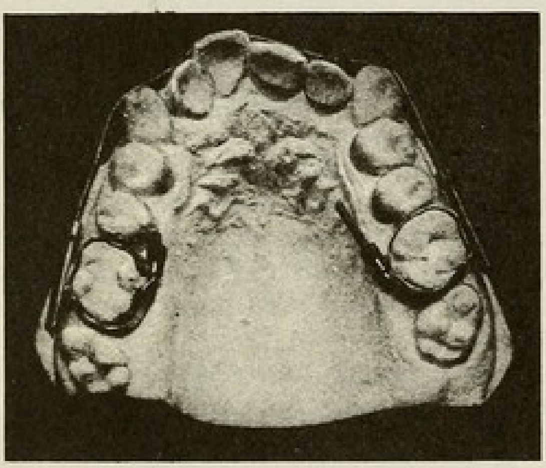
Let us now consider another important phase of orthodontic technique, namely, that of fitting bands to molars, and I wish to prelude my remarks relative to this subject with a quotation which seems to me so apt that it might almost have been written for this occasion: "That is the best mechanical device which does the work at the lowest cost. Yes, but in order to attain the lowest cost it must be able to stand up under all the stress and strain to which it is ever likely to be subject; which is to say that the engineer who designs a mechanical device, whether it be a bridge or the locomotive that passes over the bridge, must aim at *permanent* and *enduring* results. How are such results obtained? There is only one way: the engineer cannot design wilfully, capriciously, or idiosyncratically. He cannot use this material simply because it may be cheaper or look prettier than some other material. He cannot say to heat, 'I wish you would act this way,' and he cannot say to gravity, 'I wish you would act that way.' No, he must humbly submit himself to *law*. He must observe the natural order of things, and design in harmony with this order. He must select in accordance with right relations. As we say, he must plan justly and build honestly. All this he must do if he would do his duty as an economist."

As you know, two distinct types of bands are employed on molar teeth, *i.e.*, the plain brazed band and the clamp band, both having their advocates. In use each has certain advantages and certain disadvantages, but the true orthodontist will be content only with what is best for his patients—best mechanically and best physiologically. Therefore I believe both should be very thoughtfully considered in order that it may be intelligently determined which is best. Here, again, consideration of the related principles of dynamics and physiology will help in reaching a decision.

Doubtless plain bands may in skilful hands afford reasonably firm media of attachment between the teeth and the power part of the mechanism, but that they frequently give trouble by loosening under the constant jarring incident to occlusion and by reason of the strain of the appliances is undeniable, while the clamp band, even in the hands of the amateur, may be so firmly clamped as to make its accidental displacement almost impossible. Also the plain band requires to be made at the chair for each tooth on which it is to be adjusted, thus causing considerable inconvenience to the patient besides consuming much of his time, as well as that of the orthodontist, while the clamp band is ready at hand and may be quickly and easily adjusted, probably in less time than is required for the setting of the plain band in the necessary cement.

The plain band, however, has two advantages over the clamp band. First, it is less expensive, a factor which seems

FIG. 18.



to weigh mightily in its favor with many. Second, and the one which is most often exploited, is the elimination of the screw, nut and ferrule of the clamp band which necessarily interfere more or less with the functions of the tongue.* And this undoubtedly is an advantage, for every bit of material that can safely be eliminated from orthodontic mechanism is certainly advantageous, and I must admit that it is a factor of much consideration when the screw is wrongly placed in the adjustment of the clamp band, which, unfortunately, is all too often. A familiar example is shown on the right in Fig. 18. However, we must remember that a band with its clamping screw so adjusted reflects only the incompetence of the one who so places it, and not on the principle of the band, for I insist that the clamp band may easily be so placed that neither its screw nor its nut need in any way injure the tissues of the gum, and that they will be of little more inconvenience to the tongue than a plain band, especially if the brazed seam of the latter be formed on the lingual surface of the tooth.

But there is another factor to be weighed in deciding between the two types of bands which is of immeasurably greater importance than any we have so far considered, namely, the physiological demands of the gingivæ, peridental membrane and alveolar process. Which of the two types of bands is less disturbing to these tissues? And this is a question that should have the most careful thought, for if the bands that we employ for anchorage produce serious injury to the gingivæ and alveolar process, as a very considerable number are doing, it is questionable whether the improvement in occlusion that may be gained will not in the long run be offset by such injury, at least in many cases.

For a long time I have been collecting radiographs of molar teeth on which anchor bands have been worn, and the conditions often revealed have amazed me. Therefore I think it high time that this question be given the serious attention it deserves.

The story these radiographs tell is of an enormous percentage of badly fitting bands, with destruction of gingival, peridental and alveolar tissues in exact proportion to the lack of close adaptation of the band to the neck of the tooth, and this condition is often augmented by superfluous cement. It is by no means limited to cases in which plain bands have been employed, but it is more nearly universal in those cases due to the physical impossibility of gaining perfect adaptation of the margins of plain bands to the necks of molar teeth. Most orthodontists do not realize the

* The Oettinger band, wrongly called the "Lukens" band, is so bulky and clumsy in its clamping mechanism, with such lack of firmness and stability in the attachment of the anchor sheath to the band, that it must here be left out of consideration.

degree of lack of conformity of their anchor bands or the injury they cause, and many of them seem not to care. But the extent of the waste of tissue and the raw and inflamed condition of that that remains, which he must see when he removes his bands, should profoundly impress every thoughtful orthodontist. Dr. Noyes has again and again told this part of the story in eloquent words, embellished with vivid pictures one cannot forget.

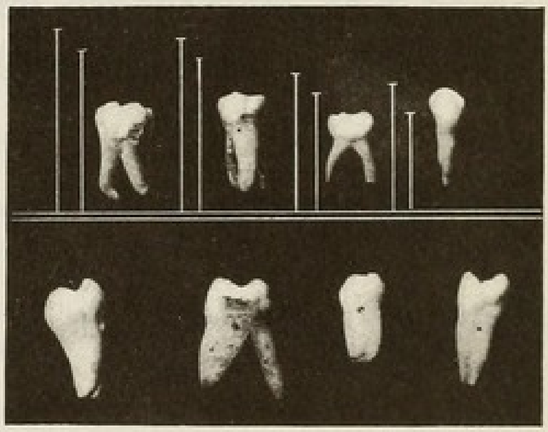
If you, also, would radiograph such tissues as they come under your observation, I am sure you would all agree that I have not exaggerated the conditions.

Do these tissues ever wholly recover from such abuse? I am afraid not.

Here is a recently made model, which I will pass among you, of a case from the first molars of which I removed two plain bands that had been worn for three years, and although three months have since elapsed you can easily see from the plaster model alone that there is still a pronounced pathological condition of the tissues about these teeth. You will also note that the radiograph reveals much destruction of the alveolar process. If you have been at all observing you have all seen many such cases.

Now I believe it is not possible to gain the proper adaptation—the necessary physiological adaptation, plus the requisite efficiency—of a plain band to a normal molar tooth. I believe this is only possible with a clamp band, and then only when the band is most *carefully* and *skilfully* fitted. This seems apparent when we consider how greatly the gingival margin of a molar band must be contracted in order that close adaptation may be gained. In Fig. 19 the perpendicular lines at the left of each of the teeth indicate the length of circumference of the several teeth at their necks and at the swells of their crowns, the difference in length of each pair of lines indicating the extent to which the gingival margin of a band would need to be contracted in order that there might be perfect adaptation of band to enamel and the least possible interference with gum tissue, a degree of contraction which in the case of plain bands it is a physical impossibility to gain in the mouth. Indeed it is not easy to so reduce metal within accurately made dies, as at least some of you know from your former experience in swaging tooth crowns. While in the mouth, if the margin of the band is pressed in at one point it is forced out to almost a corresponding degree at some other point. If trimmed away antero-posteriorly, as many who favor plain molar bands advocate, the band is weakened and its efficiency lessened just in proportion as it is cut away, for its strength can only be as great as that of its weakest

Fig. 19.



point. Besides, the portion of the band that lies gingivally to the swell of the crown in this region should be the chief dependence for preventing the loosening of the band. Certainly the effort to contract this portion of the band by means of a roughened foot-shaped plugger instead of a burnisher, as advocated by some, is not conducive to leaving a smooth surface in contact with the gum, as should by all means be done.

The difficulties encountered in making and fitting plain molar bands are reflected in the writings and discussions of those who employ them, no two, apparently, agreeing as to methods or technique, and remarkedly careless statements are often noted, as for example. "It is perfectly safe to say it (the plain band) could be fitted in one-tenth the time in which the clamp band can be fitted," etc. (See *Dental Items of Interest,* February 1917, page 102.)

Now if it is difficult or impossible for an expert in band-making to properly fit a plain band made for the tooth in hand, you need not draw greatly on your imaginations to picture what must be the fit of stock plain bands already soldered, the illustrations of which adorn the advertising pages of our magazines.

(To be continued.)

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ORIGINAL COMMUNICATIONS

Orthodontia—The Ribbon-Arch Mechanism and Some New Auxiliary Instruments.

By EDWARD H. ANGLE, D.D.S., M.D., Sc.D., Pasadena, Calif.

(Read at the annual meeting of the Alumni Society of the Angle School of Orthodontia, Pasadena, Calif., August 7, 1917.)

(Continued from page 1176.)

A NEW METHOD OF FITTING BANDS.

I have devoted much time to experimenting in fitting both plain and clamp bands to molar teeth and I now wish to offer for your consideration a method for adjusting and fitting the clamp band which I have worked out within the past year and which insures the most perfect adaptation of the band to the enamel not only at the swell of the crown, but equally at the gingival margin, thus closely conforming to the physiological requirements of all the tissues, as well as affording the greatest firmness of attachment. Also a different protective medium than cement is employed—one that is more agreeable to the tissues than cement.

By this method the operation may be best performed by following certain logical steps, thus conserving the time of both patient and orthodontist by eliminating superfluous movements. By "logical steps" I mean the necessary steps in the operation arranged in their most natural order. If you will memorize them you will soon follow them unconsciously, and learn to perform the operation easily and quickly, and I am sure you will be pleased with the results. In our clinic this afternoon I expect each of you to adjust a number of bands in accordance with this method, for it is highly important that you and all who employ it should first do the operation on teeth outside of the mouth, that you may learn the steps, as well as the necessary degree to which the nuts must be tightened in order to gain perfect adaptation.

Fig. 20 illustrates all the different

steps that readily admit of illustration in the adjustment of the band by this method. Each is important. First, a band of correct size is selected, Step 1. Step 2, the nut is turned well back and the band distended to approximately the size of the crown of the tooth on which it is to be placed. This is estimated by the eye. Step 3, the shaft of the screw midway of its length is slightly curved to conform it to the lingual convexity of the tooth. Step 4, the band is roughly squared to conform it to the general shape of the crown by three quick though gentle pinches of the band material proper between the flat beaks of pliers. I prefer for the purpose my first form of band-forming pliers, though any broad, smooth, flat pliers will answer. by means of the fingers. Great care must be taken to keep the buccal portion of the band well down upon the crown and the lingual portion at its proper height, so that when the fitting is completed the screw will be well above the gingiva. The nut is now further tightened and the band again carefully inspected to see that its position has not been changed.

The occlusal margin of the band *only* is now slightly burnished to better adaptation to the enamel, care especially being given at this time to remove any sharp bends or buckling in this margin so that the metal, upon further tightening of the nut, will flow evenly. *The gingival portion of the band should never be burnished,* as this is not only

Fig. 20.

Step 5, a sharp inward bend is given to the two occlusal corners of the band material. Step 6, an inward bend is given to both mesial and distal occlusal margins. These last four bends are necessary to prevent the band from sliding apically while the nut is tightened. Step 7, the band is turned over and a *very narrow* portion of its gingival margin, say a portion one thirty-second of an inch in width, is slightly curved inwardly. This should be done with contouring pliers that have very smooth beaks so that they will leave no roughened places or crimps at any point on the margin. Step 8, the band is turned back again and gently and carefully worked into the desired position on the tooth, the end of the shaft of the screw being brought into the closest contact with the tooth adjoining and the nut not touching the gum. The wrench is now applied and the nut tightened until the band is moderately firm, yet loose enough so that if slightly misplaced during the tightening it may be readjusted wholly unnecessary, but the burnisher cannot be effectively applied to this margin and the attempt would only injure the gum, something always to be carefully avoided.

Here a few taps from the mallet and band driver in an apical direction on the buccal side of the band are often advisable, in order to gain better adaptation and the proper height of the anchor sheath, as the latter must in all cases be *entirely free from antagonism* with the opposing tooth.

The nut must now be further tightened until the screw begins to draw lingually from the mesially approximating tooth. To arrest this undesirable movement of the screw and prevent the interference of the screw with the freedom of the tongue, the chief objection urged against the use of the clamp band, I have devised an instrument which effectively supports and holds the screw in exactly the right position while the nut is being further tightened, namely, firmly against the lingual surface of the mesially approximating tooth. It also holds the screw at the proper height and prevents the band from sliding either gingivally or occlusally during the tightening of the nut. Its use is indicated at this point. The instrument is illustrated in Fig. 21 and shown in operation at Fig. 22. It is a pair of gracefully proportioned pliers. One of the beaks is long, slender and curved to engage the buccal portion of the band occlusally to the curvilinear sheath. The other is much shorter and near its end it is bent sharply downward. It is provided with a deep groove across its inner surface, which is for the purpose of engaging the screw of the clamp band, and when it is placed in position and the handles grasped firmly and steadily held, the nut may be tightened to any degree without unfavorable displacement of the screw.

Fig. 21.

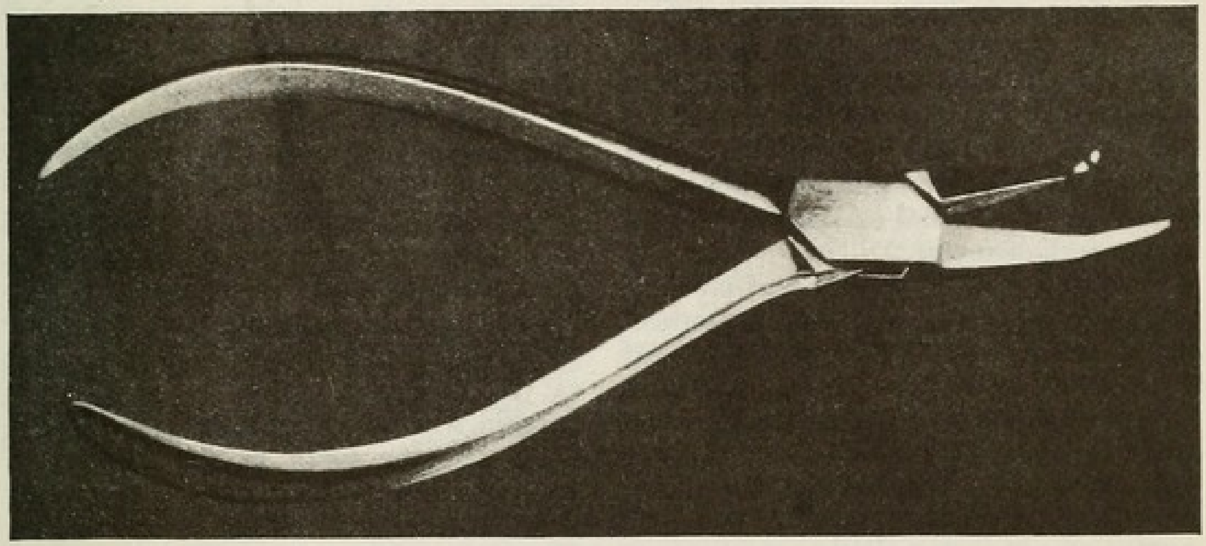
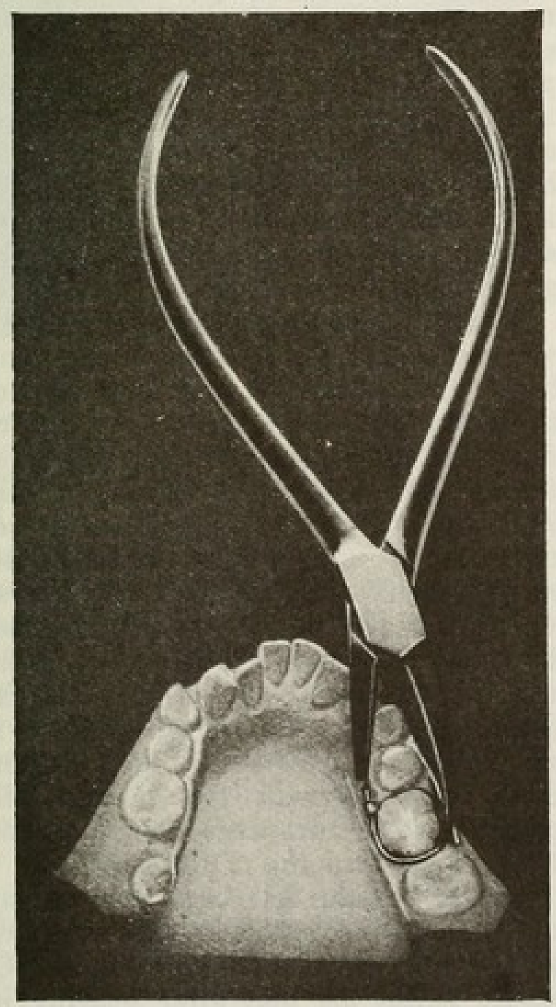


Fig. 22.



Obviously a pair of these pliers is necessary to meet the requirements of all parts of the mouth.

With firm support given the screw with these pliers the tightening of the nut is now continued until very close adaptation of the band at its gingival margin has been gained. Its occlusal margin is now accurately burnished to adaptation to the crown.

At this point the nut is loosened and turned well back and the band is carefully removed without in any way disturbing its present form gained through close adaptation. This is important. It is now thoroughly dried and a small amount of paraffin is flowed over its inner surface, the tooth being thoroughly cleansed, and the band and nut are again adjusted to exactly their former positions. A band properly made will bear sufficient tightening to allow perfect adaptation to be gained without breaking, especially if it be made of a proper quality of nickel silver. And for clamp bands I prefer nickel silver, as the precious metal lacks the stretching and consequent adaptive property possessed to such a marked and satisfactory degree by the former metal.

The screw should now be cut off on a bevel close to the nut and smoothed. There should not be a great ornamental (?) ball of metal fused upon its end, as I have so often seen done with this and other orthodontic mechanisms. This is bad mechanics. The beveled, burnished surface is always better.

The prominent corners of the nut should now be rounded and burnished, to cause as little interference as possible.

And here is something else to be avoided. You have all seen the gum injured by food being wedged between it and the nut of the clamp band. This is a condition that is wholly unnecessary and is the result of leaving the nut at such an angle as to form a V- or funnel-shaped opening between its inner side and the tooth, as on the right of the illustration (Fig. 18). Now if you will turn the nut so as to reverse this V-shaped opening, or so that the funnel will be beneath, as on the left in Fig. 18, food cannot lodge there, but will drop through the space which will be self-cleansing, the same as are the normal proximal spaces between the teeth. Think of this and act upon it.

So far I have said nothing relative to the alignment of the sheaths. When it is necessary the sheaths should be resoldered in correct alignment and this should be done just before the bands are finally set in paraffin.

PARAFFIN FOR ATTACHING THE BANDS.

Now a word with regard to the new medium, paraffin, which I am proposing to take the place of the time-honored cement. Doubtless the suggestion will occasion surprise and, of course, skepticism. It has not yet been proved better than cement. This must be determined by the test of time. But I think you will at once recognize its possible advantages over cement for molar bands. Because it has little or no cohesive power it can add nothing to the strength of attachment, but with a clamp band adjusted as I have described, no strengthening medium is necessary, as the band will be so firmly clamped and adapted to the tooth crown it could not be displaced without breaking it. In your experiments with it you will note that as you tighten the nut the superfluous paraffin will be forced from between the band and the tooth in the form of a gossamer-like ribbon, leaving but very little within, but enough to thoroughly fill any possible space. The use of the paraffin is wholly for the exclusion of moisture and the protection of the enamel, and for this it will, I believe, prove wholly reliable. Surely if paraffin is a principal reliance for the protection of modern submarine cables, we may have reason to believe that it will protect tooth enamel, and it cannot present a ragged irritating margin to the gingiva, as cement too often does.

Naturally the question will be asked, why not apply the paraffin to the band before first placing it over the crown of the tooth and thus save the trouble of removing the band for the purpose later in the operation. The reason is that when applied in the beginning it causes the band to slip and makes its adjustment difficult. But if the band is first very accurately and completely molded to the form of the tooth the paraffin will not contribute measurably to its displacement during retightening. A very little powdered emery or carborundum combined with the paraffin will probably be an advantage, as it will tend to check the slipping of the band.

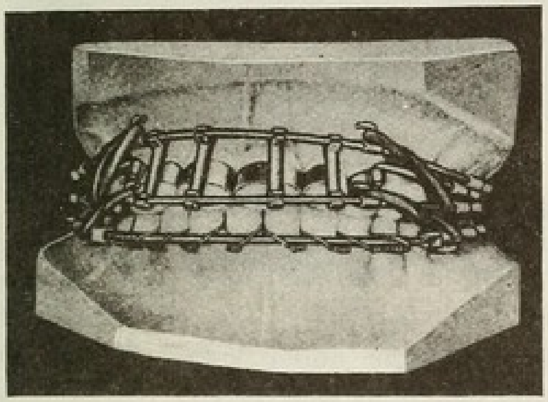
So far paraffin has been used in my own practice for about eight months, and with satisfaction. Dr. James C. Angle writes me that after wearing in his own mouth for fourteen months, with no ill results, a band adjusted as above described and set in paraffin, he is using it exclusively in his own practice.

Use it intelligently, but of course keep the necessary careful watch on it until you are certain that it is an improvement. One thing is certain: that unless you are careful and patient in thoroughly mastering the technique of fitting the band when using the paraffin you will not be successful in its use.

WIRE LIGATURES.

The wire ligature, as you all know, has played an important part in the development of orthodontia, and justly so, as it is so simple a means of applying

Fig. 23.



force, so compact, cleanly and inexpensive and, when skilfully employed, very efficient. Yet it is a surprising fact that of the vast number of times it is used each year, probably in only a small percentage of cases is it applied so as to gain its full efficiency. I have watched many orthodontists apply many wire ligatures, and I have almost invariably found that they adjust them in such a manner as to render them even at first only partially efficient, and that in a few hours this efficiency is further reduced or entirely lost.

The plan of applying the ligature commonly followed is to encircle tooth and expansion arch with a short piece of the wire the ends of which are crossed, and then with the fingers to effect a few twists. The twist so made is then grasped by pliers and more twists given. The ends are then cut off and the twisted portion bent to one side, as shown in Fig. 23.

If a ligature so applied be examined immediately it will always be found to be exerting but very little tension on the tooth, as it can be readily pushed to one side on the expansion arch with the finger nail, and if it be examined a few hours later it will be found very loose, wobbly and ineffective, and from that time until the next visit of the patient it is little more than a useless encumbrance and often a direct irritant to the tissues.

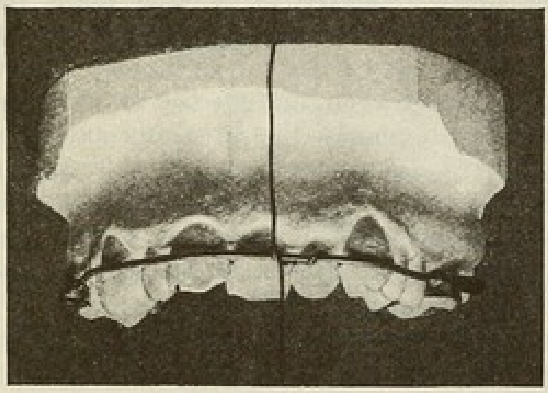
Now the error is, twisting of the ligature has been depended upon to gain the desired degree of tension upon the tooth, or between tooth and arch, when in reality very little power can be gained in that way even though the twisting be carried to nearly the breaking point of the wire. Another error is in bending the ligature to one side after the twisting, as most of the strain is then borne by only one of the strands, that on the other strand being diminished. Of course some orthodontists continue the twisting of the strands as the ligature is bent to one side, in this way maintaining somewhat more nearly equal tension upon the strands. Nevertheless the full maximum tension equally upon both—so important—is not thus gained.

All these statements can be easily verified by simple experiments, and the wonder is that orthodontists do so little experimenting, but instead usually follow unquestioningly methods that may so easily be proved to be wrong.

There is a right way of applying the ligature, or one that is certainly in far closer accord with the principles involved, by which the full amount of force desired may be gained and continuously maintained, *the twist being used only as a means of locking the strands* and holding the tension which is gained otherwise.

The two ends of a piece of ligature wire of ample length, after having been crossed, as in Fig. 24A, are firmly grasped, one in each hand, and evenly and steadily drawn perpendicularly in opposite directions until the desired firm tension has been gained. (Each end should be at least six inches long to afford ample grasp for each hand, though obviously the full length of the ligature cannot be shown in the illustration.) Then by maintaining the same steady tension, with the hands held in the same relations, the ligature is locked by giving the two ends one full turn or twist to the right. Any additional twisting is absolutely unnecessary, as it adds nothing to the firmness of the lock. It would indeed be harmful, for it would leave superfluous metal to interfere with

FIG. 24A.

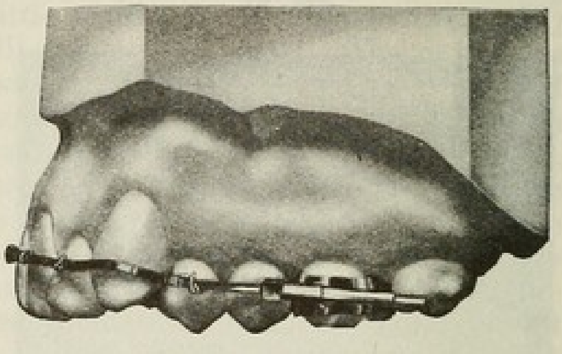


the lips. The surplus wire is now cut off with the pin-cutters, leaving ends not more than one-thirty-second of an inch in length, each of which should be closely pressed against the arch, the pressure being exerted in the direction of the twist. The result is shown on the left first bicuspid in Fig. 24B.

If the operation has been done properly the lock will not only be fully efficient, but it will not be unpleasing in appearance, will not obstruct the toothbrush, and will offer but the slightest interference with the lips, and the tension on the ligature will be borne equally by both its strands. Also, the ligature will not become loose and act as an irritant to the gums. It should be axiomatic that a ligature or any other attachment can be efficient for the control of force only in proportion to its firmness and its faithfulness in maintaining tension.

All this was made clear at the time, long ago, when I first advocated the wire ligature in preference to the fibrous ligature.* I have not, however, previously made clear, as I probably should have done, the proper way of grasping the ligature with the hands, for this has seemed to me self-evident. The ends should be grasped in the same way (the natural way) that the ends of a stout piece of string would be grasped if it were desired to break the string, namely, one firmly in each hand, the fingers closed, and the ends of the strands pressed between the thumb and forefinger of each hand, the main pull being

FIG. 24B.



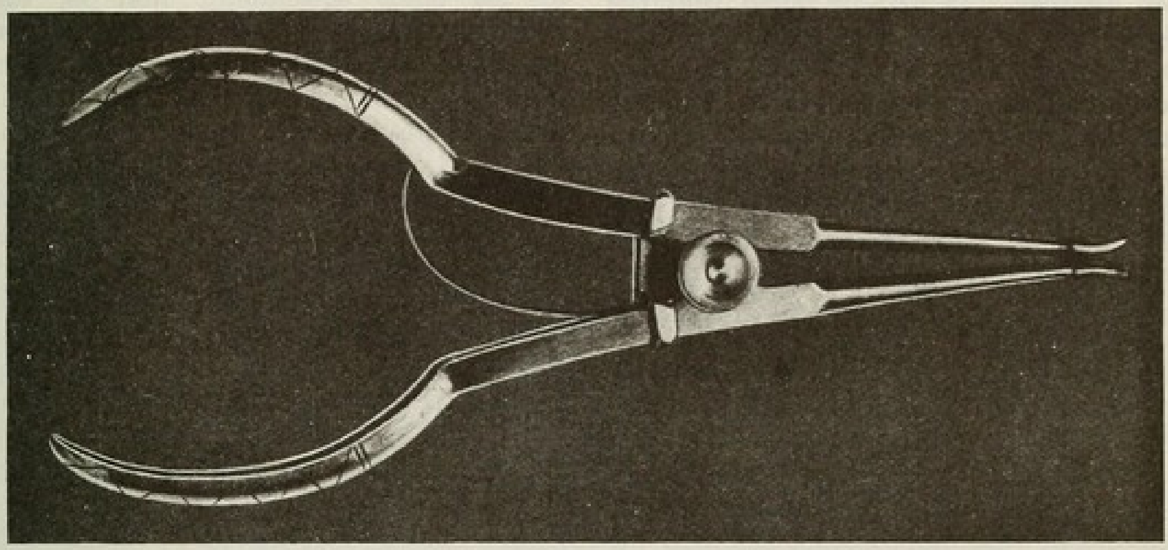
borne by the under sides of the two little fingers at their second joints. This gives a far firmer grasp than is possible when the strands are held between the thumbs and forefingers only, as nearly all will persist in doing.

Nothwithstanding the simplicity of this method of applying the wire liga-

* The temporary revival of the use of fibrous ligatures a few years ago was in all probability due to the inability of their advocates to properly apply the wire ligatures, for I am sure that anyone who masters the correct use of the wire ligature will have little use for the slippery, very unsanitary, stretchy fibrous ligature, especially the one most advocated—the silk cable—for it was found as a result of carefully conducted experiments by Prof. Raymond C. Osburn and myself, a report of which is to be published by Prof. Osburn, that these ligatures gradually stretched under moisture to a surprising extent, often more than thirty per cent. This anyone can easily verify.

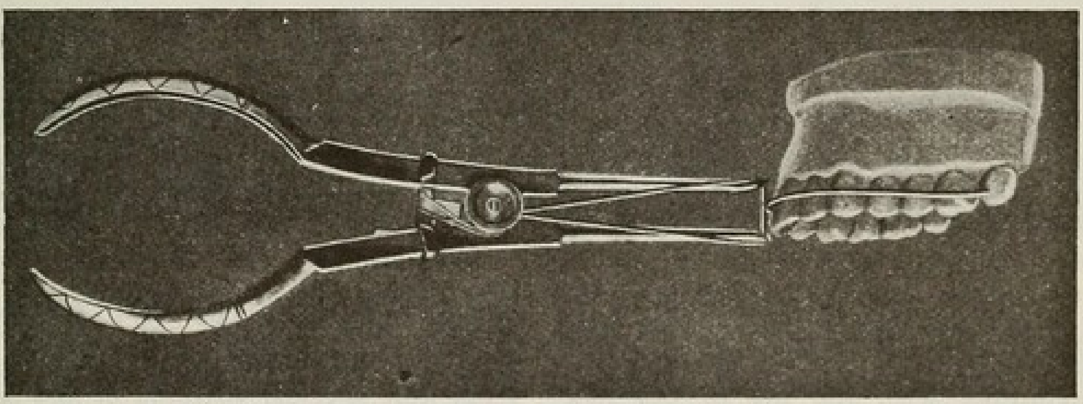
ture, I have become convinced that most orthodontists cannot or will not learn it, regardless of the amount of their own and their patients' time that is wasted through the inefficiency of wrongly applied ligatures. Pondering this, I was led to wonder if some instrument could not be devised with which to perform the operation more easily than is possible with the fingers, and with equal or greater accuracy and efficiency. I therefore began experimenting. As is usually the case with early efforts my first models were so complicated as to make them impracticable, but I continued, and now, after three years, the instrument shown in Fig. 25 has been evolved. It seems to me so nearly perfect that I show it to you with confidence today. I greatly doubt if it can be made more simple or efficient.

FIG. 25.



It is a pair of slender forceps with long beaks which separate as the handles are closed. The ends of the beaks are provided with perpendicular slots for the reception of the strands of the wire ligature after they have first been crossed in the usual way, or as they would be if they were to be grasped by the hands, as above described. After engaging the strands in these slots the ends of both strands are tightly grasped between the

FIG. 26.



thumb and forefinger of one hand and given two full turns around the tension button attached to the pivot in the hinge of the pliers, as shown in Fig. 26. By pressing on the handles of the pliers with the fingers any desired degree of force may now be given for tightening the ligature. It will be noted that the power is under the most perfect control and that it is exerted in the direction best suited to give tension to the ligature and to press inwardly upon the expansion arch, this being the main object of the ligature, namely, to spring the expansion arch toward the tooth that is to be moved and thus enlist spring tension from the arch which will act continuously upon it for a long time. Think carefully over these points. After the expansion arch has been drawn in actual contact with the tooth (which should always be done when the ribbon arch or delicate round arches are used), the handles of the pliers are locked with the slide ring with which they are provided, and rotated to the right one full turn, thus effectually locking the ligature and maintaining the full tension previously gained. The wire is now clipped off close to the inner beaks of the pliers, the latter removed, and the free ends of the wire cut off the regulation length and disposed of exactly as previously described.

No human hands can apply and control force so evenly and painlessly in the placing of the ligatures, and a ligature so placed will not become loose and a source of irritation to the soft tissues.

In learning to use these pliers you will at first break ligatures, as force is exerted so easily with them, but, as in the use of the new band-forming pliers, in a little while you will learn the right "feel" as you press the handles, and will be delighted with the use of the new instrument.

Another point. Discard for all time the smallest ligature wire. It has no advantages over the medium and large wires, but the decided disadvantage that it cannot be firmly locked under the tension that would be necessary to make its use efficient for the movement of teeth, due to the slight amount of metal it contains.

THE ORTHODONTIC WORK-TABLE.

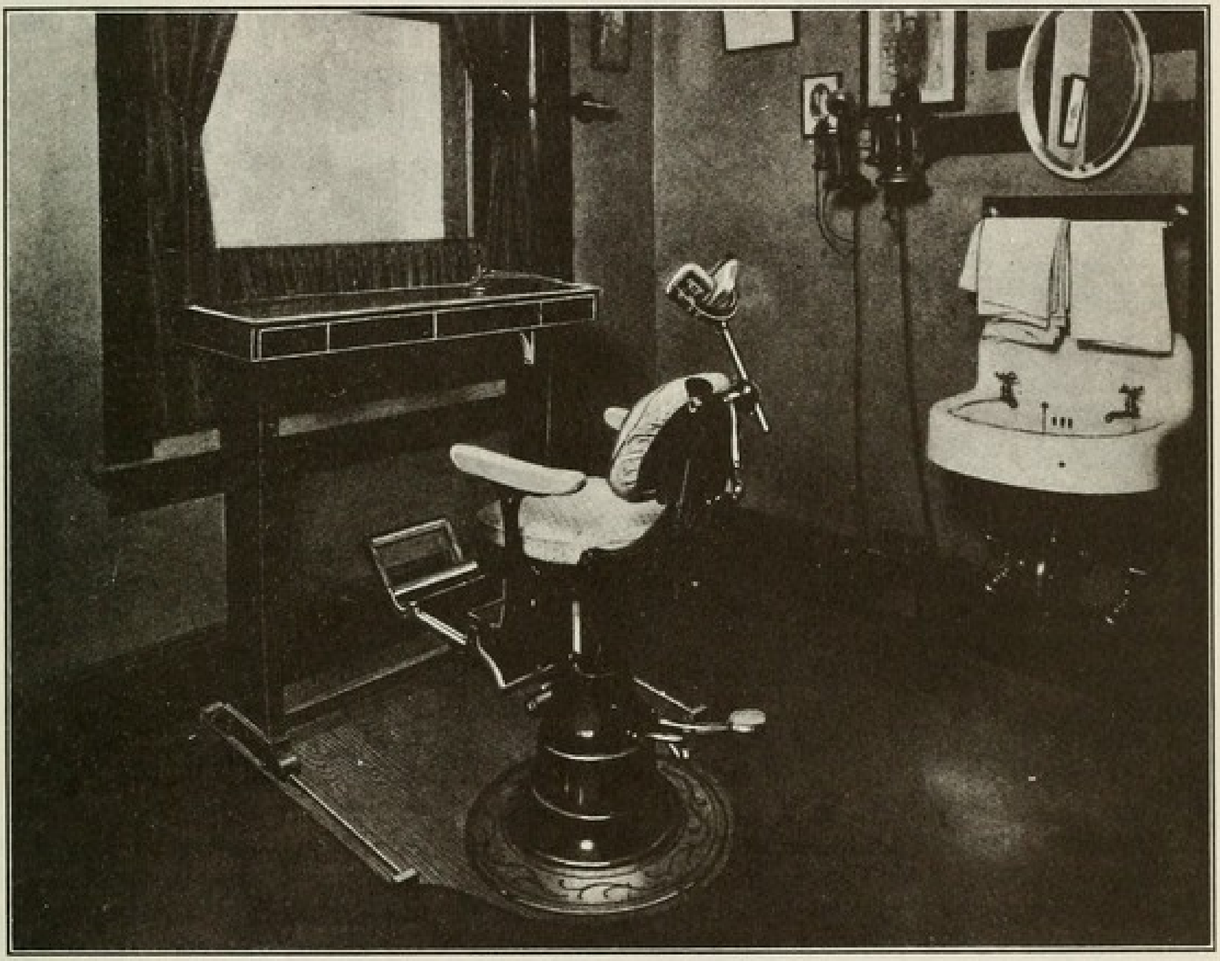
The orthodontist, as you know, has inherited from dentistry the larger part of his office equipment, that is, the swinging bracket, the cabinet, engine, cuspidor, laboratory work-bench, etc. Now all of these are doubtless beautifully adapted to the needs of the dentist, and they represent the fruits of many of the best minds in dentistry for many years in the elaboration and refinement of dental furnishings. But they are by no means best suited to the needs of the orthodontist, for his work is radically different from that of the dentist, naturally requiring just as different tools and fittings for his convenience. Very important among these is a suitable bench or table which shall also be a receptacle for his instruments, and this should be close at hand so that he need not be compelled to make frequent excursions to a cabinet more distant from his patient, or to a work-bench in his laboratory. In watching orthodontists at their work I have often noted that frequently more time is consumed in such excursions than is required for the actual work in hand. Besides, *such interruptions are very disconcerting in the delicate technical work on which the eye and mind should be concentrated, and tend to impair its quality.*

Fig. 27 illustrates a work-table which I believe to be far better suited to the needs of the orthodontist than anything to be found in the dentist's equipment.

The wobbly and unsteady dental bracket and the dental cabinet long ago became unsatisfactory to me. Then came the wall bench, shown in both the sixth and seventh editions of my book. This was better, but the constant diversion of thought necessary in turning away from the patient to the bench attached to the wall at the side of the window led me to place a stationary shelf directly in front of the window, but the distance between shelf and patient was still too great. Then came the thought of a movable table, to be placed directly in front of the operating chair. It seemed promising. So a table of rough workmanship was constructed and then repeatedly modified until the proper height and width of top, width between the legs to permit the lateral swing of the footrest of the chair, number and dimensions of drawers to render it most convenient, had been carefully worked out. It was then given over to our beloved teacher of art, Mr. Wuerpel, who very kindly gave it much consideration, and, while maintaining the previously determined proportions, worked out a design of pleasing outline for the table. This pattern was then taken to a very reliable firm of great experience in the making of fine furniture to work out the best way to construct the table in order that it might have the requisite stability with the desired lightness and delicacy. The result is as you see it—a very firm and substantial, yet graceful table.

The top of the table is of sufficient size to afford plenty of room to perform all of the various operations of band-making, soldering, cement-mixing, impression-taking, etc. The table contains four drawers of generous size which, being divided and subdivided by partitions into compartments, furnish ample room and to spare for a stock of all necessary instruments and appliances, absorbent materials, etc.

Fig. 27.



There is a natural place at the left end of the table for the assistant to stand, where she may be in close touch with the work and ready for instant cooperation.

A very important feature of the table is that it is provided with four large, very true casters that have mechanically accurate bearings and that move on a novel form of track, so that the table may be noiselessly moved backward or forward as easily and with greater certainty than the usual dental bracket is moved. In fact, the friction of the index finger on top of the glass slab which covers the table is sufficient to move it as desired, and the orthodontist soon forms the habit of moving it unconsciously to be near to his patient or farther away as he at the moment requires, without loss of concentration on the immediate work in hand.

The receptacle for the spraying fluid, the Grünberg soldering lamp, etc., are caught on hooks at the back of the table where they are out of the way, and, what is better, out of sight when not in use, yet always within easy reach when required.

One objection to the table which will doubtless be raised is that in some instances it may interfere with the connections with the fountain cuspidor. But I think that these elaborate, bulky cuspidors can with advantage be dispensed with in orthodontists' offices. While they are necessary to oral surgeons, rhinologists, exodontists and dentists, the orthodontist, not being a blood-letter, does not really need a fountain cuspidor. In fact, he has but little use for a cuspidor of any kind. My own is a beautiful Japanese bowl which occupies an artistic pedestal in a corner of the room where it is out of the way. When it is needed it is brought on its pedestal to the patient by the assistant and then returned to its place after it has been cleansed.

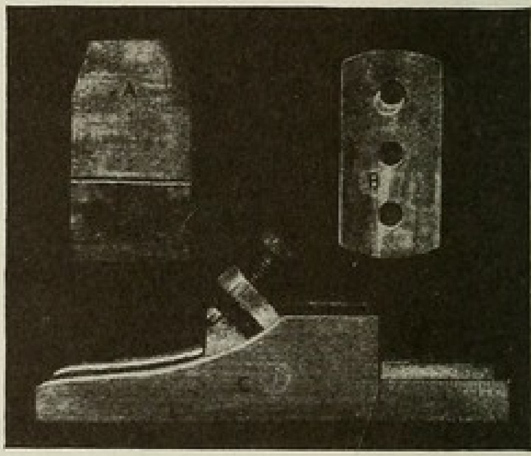
Of course this table will not meet the demands of the "old school" orthodontist who requires a miniature machine-shop with innumerable tools for the construction of his appliances from raw materials, but for the truly up-to-date orthodontist it meets all requirements.

Some twenty of these tables are now in use among my former students and all are greatly pleased with them. With this table, in conjunction with the beautiful, graceful child's chair, I am sure the work of the modern orthodontist will henceforward be much easier than heretofore and the general appearance of his operating room greatly improved.

PLASTER PLANE.

As you all know, accurate models of the teeth of patients are indispensable to the modern orthodontist, and, as I long ago pointed out, a man's skill and ability as an orthodontist can be quite accurately estimated by the skill he displays in making models and in his appreciation of them. So anything that will assist in the production of good models is obviously desirable.

Fig. 28.



The model plane, c Fig. 28, has become recognized as a necessary part of our equipment, yet to be of much use the blade of the plane must always be kept extremely sharp, and unfortunately but few ever learn to keep it in proper condition. So here is an idea that is practicable and will be found very helpful to this end. It is to face the hard brass blade of the plane with steel. To do this, flow a little soft or tin solder over the face of the brass blade, distributing it evenly while in the molten state with a pledget of cotton saturated with soft-soldering fluid; also apply soldering fluid to the clean surface of a safety razor blade (Gillette's are best, b Fig. 28); then clamp the razor blade into the exact position desired on the brass blade with paper clips and slowly, very slowly, heat over the flame of an alcohol lamp until the solder melts. Do not carry the heat beyond the melting point of the solder or allow the flame to come in contact with the projecting edge of the steel blade or its fine temper will be ruined. The surplus ends of the steel blade should be removed by grinding a shallow groove across them with a thin carborundum disk, when they can be easily snapped off and the remaining ends made even and true by grinding. The result will be a very fine cutting blade of excellent quality, A Fig. 28, and one so thin that it may be quickly sharpened on an Arkansas stone.

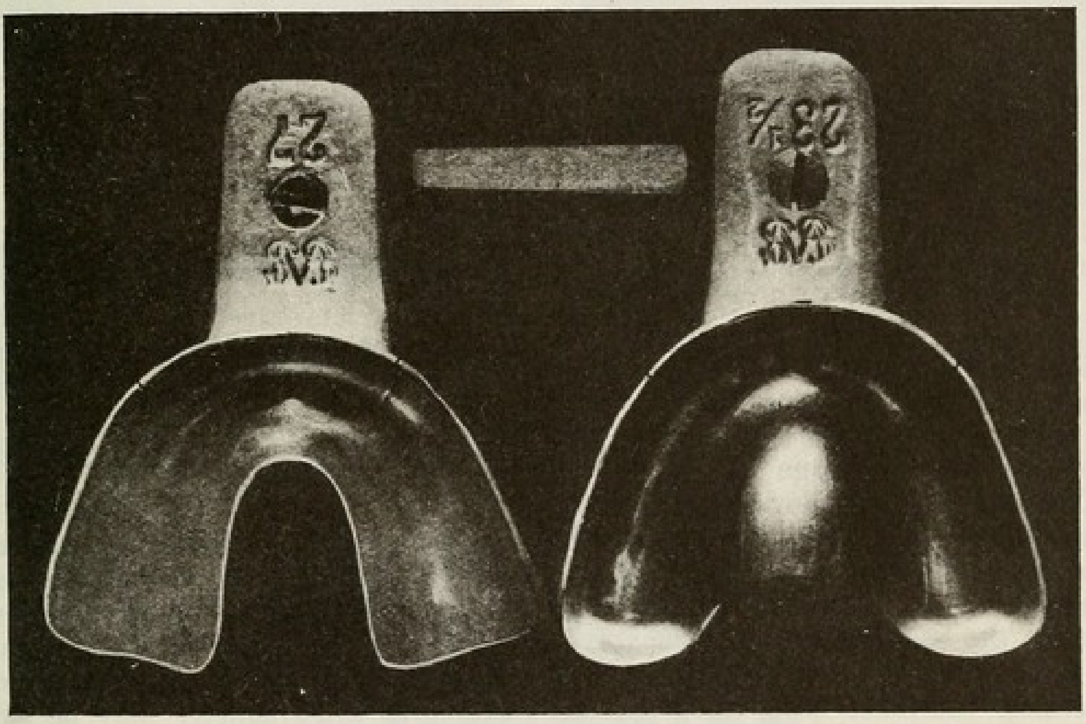
I am glad to learn that one of our number is working on a high-speed motor plane that promises well. I am sure we all heartily wish him success.

IMPRESSION TRAYS.

Here is an idea given to me by one of the laity, which lessens the difficulty of impression taking. It is to saw two perpendicular slots in the outer rim of the impression tray at points corresponding to the normal location of the cuspid teeth (Fig. 29). After the tray and plaster have been seated in the mouth little strips of metal are inserted in these slots and allowed to remain until the plaster has set. (One of the little strips is shown between the two trays in the illustration Fig. 29.) They are then removed, together with all loose pieces of plaster, followed by the removal of the tray which will be found to loosen readily as the slots admit air. The plaster is then easily broken at these weakened places, the time and trouble of cutting the grooves, heretofore necessary, thus being saved; also, in most cases, reducing the number of breaks in the impression. I now use this plan altogether and it is excellent.

The little strips of metal should be straight, smooth and quite stiff, and about one and one-half inches long. They are best made from heavy separating files, as the latter are of proper width, thickness and rigidity.

FIG. 29.



It should be needless to caution you that the slotted tray must not be bent out of shape while placing it in the mouth, as it might easily be.

THE BRACKET ATTACHMENT IN RETAINING MECHANISM.*

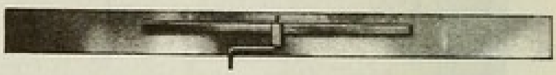
It would be difficult to imagine a more efficient means of retaining teeth, after they have been moved into the desired positions by means of the ribbon arch, than the same mechanism that effected the changes, and indeed it may be so employed to advantage for a few weeks, at least, until the teeth have become somewhat habituated to their new positions. Then this mechanism may be wholly removed and a type distinctly for retention substituted, or the original mechanism may still be continued, gradually dispensing with certain portions of it as they become no longer necessary; for example, one or both of the anchor clamp bands, together with greater or less portions of the sides of the arch, finally gradually reducing the length of the remaining anterior segment or even removing a portion from its center, etc.

This plan I have followed successfully in a number of cases, but as the retention period is distinct and of marked importance in treatment, often necessitating the wearing of the mechanism for a considerable time before the forces governing occlusion have become thoroughly normalized and working harmoniously (even indefinitely if pernicious tongue or lip habits have not been overcome), it seems to me the part of wisdom to employ for the purpose only such mechanism as will be in the very closest accord with the requirements of retention, *i.e.*, with physiology, art, dynamics and hygiene. These requirements of course do not materially differ from those of active treatment except as to art and dynamics, but as very little force is required to statically maintain teeth in their normal positions, there may be less sacrifice of art and hygiene to dynamics. Therefore the retaining appliances may be more delicate than those employed for treatment, and they may also largely be placed lingually to the teeth.

Now as no form of orthodontic mechanism is more simple and efficient than the ribbon arch and its attachments, nor more easily adjusted and manipulated, its modification to conform to the demands of retention required little more than to increase its delicacy. Realizing this I have so modified it.

As nearly as I have been able to determine by experimentation, most of

FIG. 30.

A

B


the parts may be reduced a little more than one-third and still have ample strength, that is, the bracket in length and width, and the band material in width; and for most cases plain round wire .022″ in diameter may be substituted for the ribbon arch. For special cases where there has been lingual or labial movement of roots which require support, flat or "ribbon" wire will be necessary, but it need not be more than .028″ in width instead of .036″.

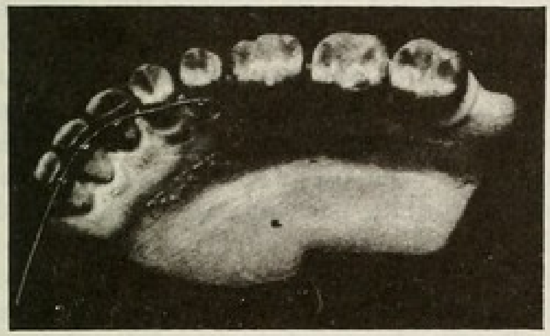
The parts of original size for active treatment, and as reduced in size for retention, are shown in Fig. 30, the round wire being locked in position in the bracket in the second piece of band material; the delicate, flattened wire being beneath it. I hope in due time the two wires and the bands and brackets of reduced size for retention will be furnished us by the manufacturers.

In use the bracket bands are most carefully and accurately fitted to such

* All that I have here to say with regard to retention was ready at the time of our last meeting at New London, Conn., but the allotted time was too short to permit its general presentation. It was, however, discussed with a few privately.

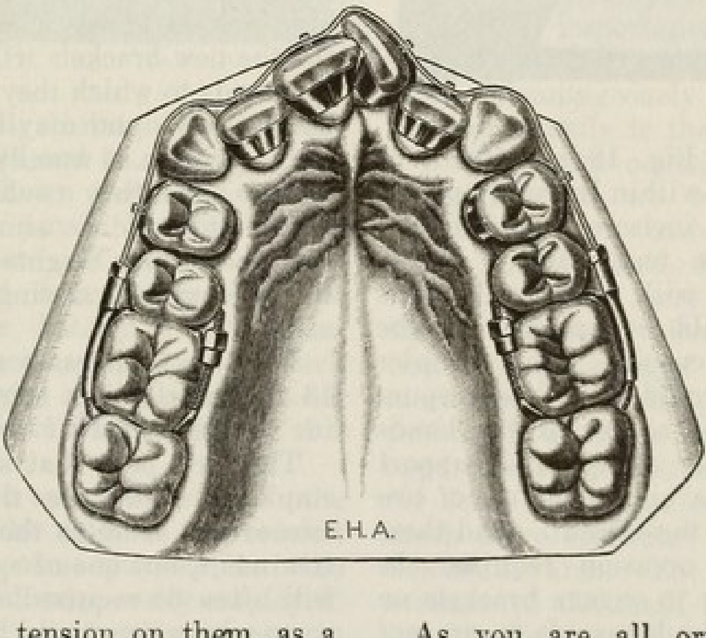
teeth as require banding, either for special support or for anchorage. The round or flat wire is then bent and very

FIG. 31.



easily seated in the brackets by means of the fingers, and effectually locked with the pins, after the manner shown in Figs. 31 and 32. Great caution should be observed to shape the wire before seating it so that it will lie passively in its relations with the moved teeth, otherwise it

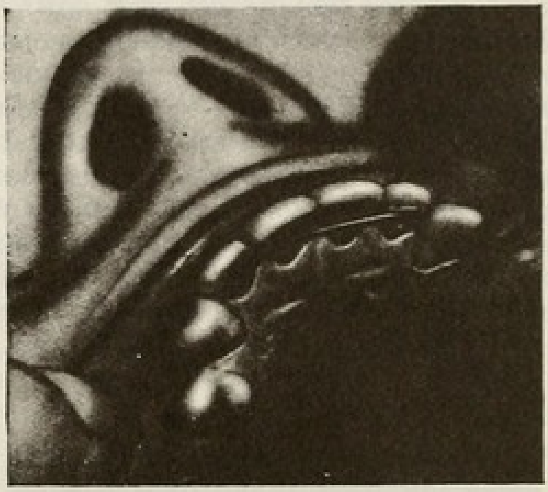
FIG. 33.



will exert undue tension on them, as a result of which they will soon be moved out of their corrected positions.

The great advantages of this form of mechanism over that with brazed attachments are its ease of application and especially of modification. If it becomes necessary to modify it for readjustment of a tooth that has dropped slightly out of alignment the wire may simply be unlocked, removed, its form modified as

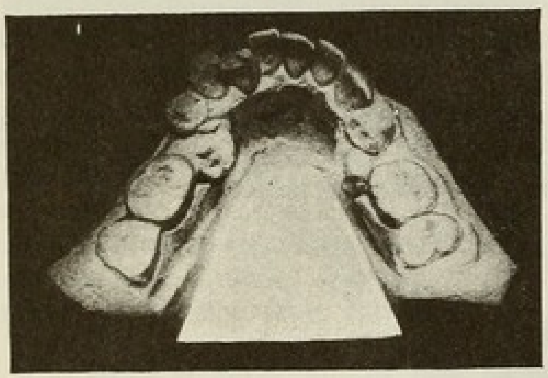
FIG. 32.



required, and replaced, all with the greatest ease and very quickly. It is a true "working retainer."

As you are all orthodontists, with abundant experience in the retention of teeth, it does not seem to me necessary to show you numbers of cases of types commonly met with in the various classes of malocclusion that may readily be retained with this form of mechanism. You should at once see its advantages over the usual brazed attachments and easily realize how greatly your time and that of your patients may be conserved in its use, and how perfectly the static force required for each individual tooth may be controlled. I do not for a moment suppose that we can ever entirely dispense with brazed attachments, as this form of attachment represents the maximum in strength and delicacy. It is therefore the most desirable in some instances, yet I feel certain that in most cases the more convenient bracket attachment can now be substituted for it with advantage. Very often we may combine the two in the same apparatus.

Fig. 34.



For example, in Fig. 18 a segment of wire made to rest within lingually placed brackets on the incisors would effectually retain these teeth, and a longer segment of wire with additional bands and brackets could be applied for the retention of the cuspids, but a simpler and better plan would be to solder spurs to the disto-labial angles of the bands on both laterals to engage and support the cuspids, thus avoiding the use of two extra bands upon these teeth. And these spurs might, if occasion required, be continued distally to engage brackets on one or more of the bicuspids to prevent their lingual or rotatory displacement, etc.

In retaining the teeth in the case shown in Fig. 33, after their present positions had been corrected, practically the same combination as that just described could be used, substituting it for the mechanism now shown upon the teeth, but employing the two bicuspid bands already in position.

Although the illustration, Fig. 34, represents a very poorly made model, selected from a large number that have been sent me, it is sufficiently accurate to illustrate how very effectively the bracketed bands supporting a lingual arch of round wire would retain these badly malposed teeth after the dental arch had been properly enlarged and the teeth brought into correct relations with the line of occlusion. In its application the retaining bands would be placed on the second bicuspids and the cuspids, the arch, after having been carefully shaped, being seated in lingually placed brackets on these teeth. To give additional firmness to the two ends of the wire, spurs should be soldered to the disto-buccal angles of the bands on the second bicuspids to bear against the mesio-buccal angles of the first molars.

Of course where the "bite" is very short the brackets would so interfere with opposing teeth as to make their use impracticable on the upper dental arch, but such instances should be very rare, for the new brackets will be so short and the bands to which they are attached will be so narrow and may be placed so close to the gingiva as usually to give no interference. If they could not be so employed it would be almost certain proof that the proper heights of the teeth had not been gained during the prior treatment.

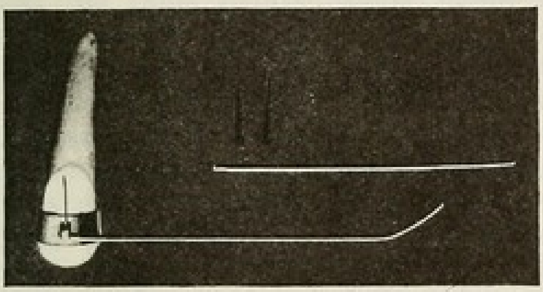
Even in such cases as shown in Fig. 13 this mechanism could easily be used for the retention of the upper incisors.

The lock pins that should usually be employed would be those of standard size or the same as those used in active treatment, but one of special proportions will often be required. For example, if spaces between teeth have been closed the teeth may be prevented from sliding along the wire and again separating, by filing a delicate notch in the side of the retaining wire directly opposite the pin slot in the bracket, and, instead of the usual pin, inserting one of greater width, which will engage both the bracket slot and the notch in the wire. This will serve the double purpose of locking the wire within the bracket and of preventing the tooth from sliding laterally. The same plan may also be employed to prevent the sliding of teeth in the opposite direction and closing space that has been gained.

The width of this pin will be .004" greater than that of the standard pin, but it will be of the same thickness. It is shown in comparison with the standard pin in Fig. 35.

It is very efficient and may often be used in other ways, important among which is to support the end of the retaining wire that it may not slide distally or

Fig. 35.



be pulled mesially through the bracket, etc., as in Figs. 31 and 35. In this illustration is also shown the notch for the reception of the pin in the side of the detached wire near one end.

If it is found desirable to shift the wire mesially or distally, either in retention or in treatment, another notch is made in the wire at the point desired and the pin made to firmly lock it in this position.

Cleats or little spurs soldered to the wire to engage the sides of the bracket would effect the same purpose, but the pin is simpler and more easily employed.

I know that many will attempt to apply this special pin in so bungling a manner that it will not be successful in their hands, but to the orthodontist who appreciates the advantages of delicate mechanism and will learn to employ it correctly by first properly locating with a suitable instrument the exact point at which the notch is to be made in the wire, and will then file the notch at the proper angle and to the proper depth, so that the pin may be mechanically seated, it will be a source of much satisfaction. Of course the wider pin may be employed with the wider ribbon arch and usual type of bracket, when desired.

There is another use for this more delicate arch-bracket mechanism which I think will appeal to you all. It is for correcting malpositions of deciduous teeth or recently erupted permanent teeth in mixed dentures, where it may be used either lingually or labially to the teeth. The power will be found ample for the movement of such teeth in a physiological manner. I might give you many examples of where it could be so employed, but already you should see its many possibilities and advantages in numerous cases that must now be pictured in your own minds. I hope you will study it most carefully and employ it intelligently, and if you will do so you will know that we have made progress this morning.

This is a good time to discuss another question of importance, namely, whether orthodontic mechanism can be employed more advantageously lingually to the teeth or labially to them.

I believe the question is not difficult of solution if we will again employ principles as a basis from which to reason and to make deductions.

Now it seems very clear to me that the most natural place for the application and operation of active orthodontic mechanism is labially and buccally to the teeth, as there is here far greater opportunity for the freedom of force and for force control as compared with the much more restricted lingual region of the dental arch. The labial and buccal surfaces of the teeth are broader, offering greater possibilities for power grip, besides being decidedly more accessible for the application of mechanism which here offers less interference with the functions of the mouth and is more easily kept clean by the patient. Compare for a moment the possibilities of force control of appliances operated lingually to the teeth with those operated labially in the rotation of cuspids, bicuspids or incisors, or in fact for the considerable movement of any of the teeth, and you certainly must realize that the advantages are greatly in favor of those operated labially.

Of course by no means would I restrict active mechanism to the labial and buccal surfaces of the teeth, for instances may occasionally arise where lingual mechanism would be more advisable, as for example, in very simple cases of very young patients, where the simple widening of the dental arch, possibly accompanied by slight movements of incisors, is required. Indeed all movements of the teeth may be accomplished with lingually operated mechanism, but much more time would be required for the same movements, as well as great inconvenience caused both patient and operator, than if it were operated labially. I think this fact, in many cases, at least, accounts for the enormous amount of time that is wasted by many orthodontists in the treatment of their cases.

I had hoped to discuss still other questions relative to treatment with you today, but lack of time will make necessary the deferring of them until our next meeting. Meantime I would leave these simple injunctions with you: think more sharply; reason more carefully; work more delicately and accurately.

1025 N. MADISON AVE.

Special Mechanism for the Treatment of Deciduous and Mixed Dentures.*

By EDWARD H. ANGLE, M.D., D.D.S., Sc.D., Pasadena., Calif.

NO thoughtful student can fail to be deeply impressed by the great part the deciduous denture plays in shaping the growth of the permanent denture; if normal, helping to perpetuate the normal, and if abnormal, perpetuating the abnormal. For we now know that the same malocclusions found in permanent dentures are also found in deciduous dentures, though in the latter they are usually less in extent than in the former. Indeed, in very many instances malocclusions of permanent dentures are but accentuated duplicates of those of the preceding dentures, and this is necessarily inevitable unless the cause which has disturbed the balance of the mechanical forces of the deciduous denture is recognized and early removed, when Nature will often correct the perversions of occlusion without further aid.

Of course all such self-cures are possible only in the early developmental stages of the malocclusion, or before such complications as the inlocking of teeth, or the abnormal mesio-distal locking of the teeth of the opposing arches, etc., have occurred, after which mechanical assistance is always necessary, not only to arrest the further development of the malocclusion, but to correct that already existing.

It is of course true that not all malocclusions found in permánent dentures had their origins in the preceding deciduous dentures, although it is not yet known even approximately to what extent this condition obtains. It is believed by the author, however, to be of far greater frequency than has hitherto usually been supposed, and certainly far less attention has been given the subject than its great importance deserves.

DESIRABILITY OF EARLY ORTHODONTIC TREATMENT.

As late as the publication of Guilford's last book no orthodontic treatment of deciduous teeth was considered necessary or advisable, and indeed not much interest was awakened in early treatment nor had its importance begun to be appreciated until the appearance of the seventh edition of the author's "Malocclusion of the Teeth," in which was reported the treatment of a well-defined case, belonging to Class II, Division 1, of a boy three and one-half years of age and the many decided advantages of so early a restoration of the balance of the forces of the denture, permitting it thereafter to function normally, were pointed out.

Many similar cases with like successful results have since been reported. With the cause removed (usually abnormal habits, such as sucking or biting the lips, cheeks, tongue or fingers, pressure on the face from the open or closed hand during sleep, or throat and nose lesions) and the normal reëstablished before both causes and effects have become so firmly fixed as to be difficult or impossible to remove or overcome, the succeeding normal growth of the permanent denture is made not only possible but reasonably certain. And the facts that malocclusions of deciduous dentures are far less complex than corresponding

* Extracts from the author's forthcoming work on "Orthodontia."

types in permanent dentures, hence requiring correspondingly less tooth movement; that teeth may be moved with greater ease at so early an age of the patient; and that, due to the foregoing facts, the time required for treatment may be proportionately decreased—these, together with the great improvement in general growth and development of the child incident to thus early restoring the normal functioning of the denture, seem to prove that the opportunities for our most signal successes lie in the treatment of malocclusion very early. The author believes that the true orthodontist of the near future will possess such knowledge and skill as will enable him to promptly recognize and intelligently remove the disturbing influences to growth and development in deciduous and early mixed dentures, and, if necessary, promptly correct existing malocclusion and thus prevent the development of complications, so inevitable, if the abnormality is allowed to progress, and that by far the greater percentage of his patients will then be those of early childhood.

Notwithstanding the lately growing recognition of the importance of early treatment, as yet little attention has been given to the devising and constructing of mechanism especially adapted to the correction of malocclusion of deciduous dentures and none, other than that improvised for the treatment of the particular cases reported, has so far appeared in the literature, the same plan in its devising having been followed that was for so long pursued by practitioners of the old school in the treatment of all cases.

Now, since the same classes, types and conditions of malocclusion occur in both dentures, and since the problems presented in their treatment are so similar, mechanism operating on the same general principles may be employed on both. For many years the mechanism for correcting malocclusions of permanent teeth has been undergoing marked evolutionary changes and coming more and more nearly to fulfilling the requirements of physiology and dynamics in treatment until, in its present highest state of development, it meets the needs in a highly satisfactory manner. Yet, notwithstanding the similarity of the problems of treatment of permanent and deciduous dentures, the mechanism best suited for use on the former requires to be somewhat modified for use on the latter in order to fittingly accord with the modified conditions of growth and development of both denture and patient in general. First, deciduous dentures are much more diminutive and patients so young lack the understanding and appreciation of older children and often fail to lend the same coöperation. Again, wonderful and very rapid structural changes that can not without injury be interfered with are taking place in their tiny jaws, especially just underneath their little teeth, and these impose certain restrictions and limitations which must be fully realized and conformed to both in the mechanism employed and in the manner in which it is operated. For example, it is always bad practice to interfere with and restrict the functions of the permanent denture over long periods of time, since this is unphysiological and often attended by serious results and even permanent injury to the developing structures, as elsewhere pointed out, and it is especially to be avoided in deciduous dentures for obvious reasons, of which one only will be here mentioned. As is well known, the wearing of active orthodontic mechanism on the deciduous teeth often tends to cause absorption of their roots, this often causing the loss of their crowns also, long before the latter would normally occur, with the inevitable train of attendant evils. However, the absorptions and other injurious effects are usually proportionate to the instability of the appliance and the variability in amount and direction of the force exerted by it, especially when worn, as it now so commonly is, for periods of interminable and wholly indefensible length.

Obviously, then, the mechanism which should be employed should be of the greatest possible simplicity and delicacy and yet best accord with the laws of mechanics in efficient operation and in the control of force in order that the work may be completed with physiological promptitude. Also it must admit of being so placed as to cause the least possible interference with the tongue and other tissues and inconvenience to the little wearer, for it is now known that interference with the functions of the tongue by improperly constructed and located orthodontic appliances may cause pernicious tongue habits which ultimately defeat the very object of treatment. And it must be so firmly attached as to be practically free from liability to accidental displacement and the consequent danger of being swallowed, which is greater than with older patients.

There is but one natural, logical place for the wearing of active orthodontic mechanism, where it offers minimum inconvenience to the patient and minimum interference with speech, mastication and deglutition, where it is most easily applied and operated, and where there is the greatest freedom for the exercise of the best principles of mechanics in force control both statically and dynamically, and that place is not within the lingual cavity.

Fig. 1.

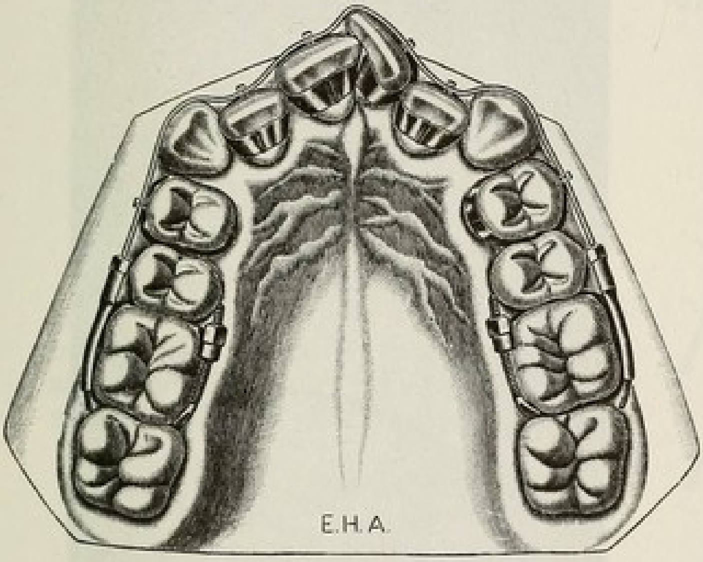
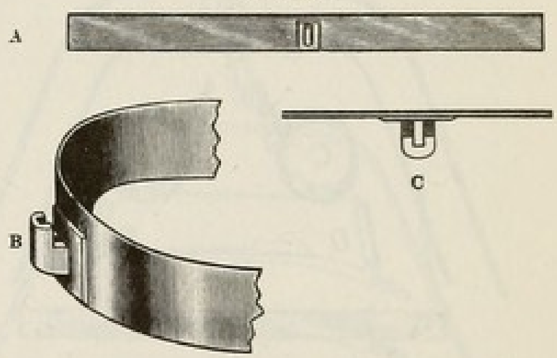


Fig. 2.



THE "TINY" RIBBON ARCH MECHANISM.

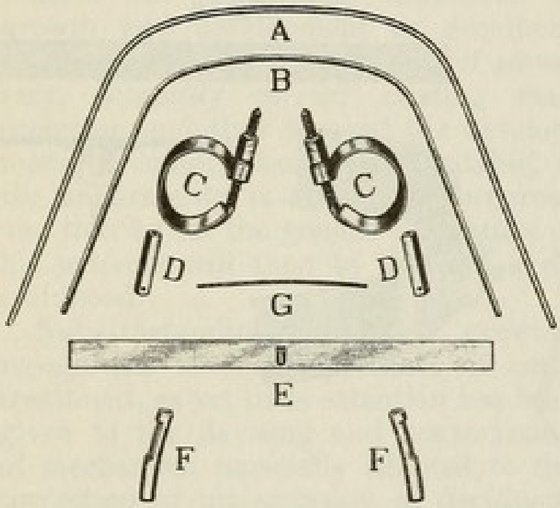
The mechanism for the treatment of malocclusion of deciduous and mixed dentures, which we shall now describe, is the product of long consideration of all the problems involved, and of so much experimenting and refining as that it now very satisfactorily fulfils the demands of physiology and dynamics in treatment. In principle, as indicated, it is the same as the larger ribbon arch mechanism used on permanent dentures (Figs. 1 and 2), with which most readers are familiar, but so simplified and reduced in size as best to meet the needs of deciduous and mixed dentures. It is made of the same precious metals as those which have proved so satisfactory in the use of the standard ribbon arch mechanism,* and the proportions of parts with relation to the necessary strength have been carefully worked out and all material not actually necessary eliminated. It is called the Tiny ribbon arch mechanism, all the various parts of which are shown unassembled in Fig. 3, and assembled, on the teeth, in various illustrations that will follow.

Since far less power is needed in the treatment of malocclusion of deciduous and mixed dentures than in that of per-

* Clamp bands made of nickel-silver are greatly preferred by the author for reasons elsewhere pointed out, and the Tiny sheaths in nickel-silver equally answer every purpose of those in precious metal, at much less expense.

manent dentures, the whole mechanism is very delicate. The Tiny ribbon arch, A, Fig. 3, is but .026" in width, the Tiny bracket band, E, but two-thirds the width of the standard bracket bands, the Tiny brackets being proportionately reduced in size but used with key pins of standard size. The Tiny clamp bands, CC, are exact duplicates of the author's standard clamp bands Nos. 1 and 2, except that they are reduced in all dimensions to accord in size with deciduous first and second molars. A round arch .022" in diameter is shown at B, Fig. 3, for use when it may be desired to merely tip teeth into position.

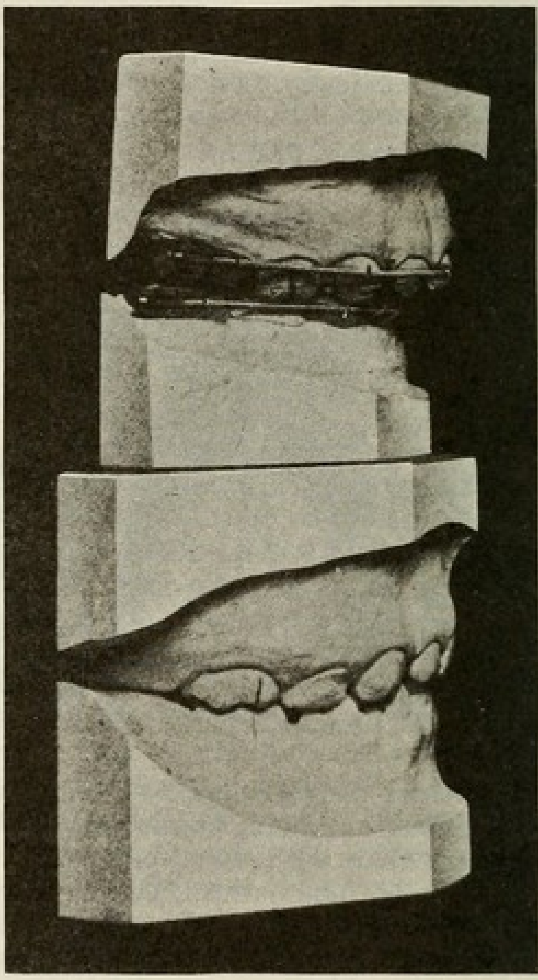
FIG. 3.



Far less adjustment of the mechanism being required to meet the changing size of individual dental arches during treatment than is necessary in the use of the larger ribbon arch mechanism on older dentures, radical changes from the usual method have been made in the manner of attaching the arch wire to the anchor teeth and of gaining power from the anchorage base. Several of these will be shown, each of which has certain advantages under special conditions and permits of greater simplicity and delicacy of the mechanism than the screw method of adjustment, so valuable where greater power and range of adjustment are required, as in the treatment of permanent dentures, and also permits the use of an arch wire which, being unthreaded, affords full elasticity and strength throughout its entire length.

The first method to be described is that in which is employed the Angle-Atkinson anchor sheath, F F, Fig. 3, the tang wires, G, the Tiny clamp bands, C C, the Tiny bracket band, E, and the Tiny ribbon arch, A, all as shown in position on the teeth in Figs. 4, 5 and 6.

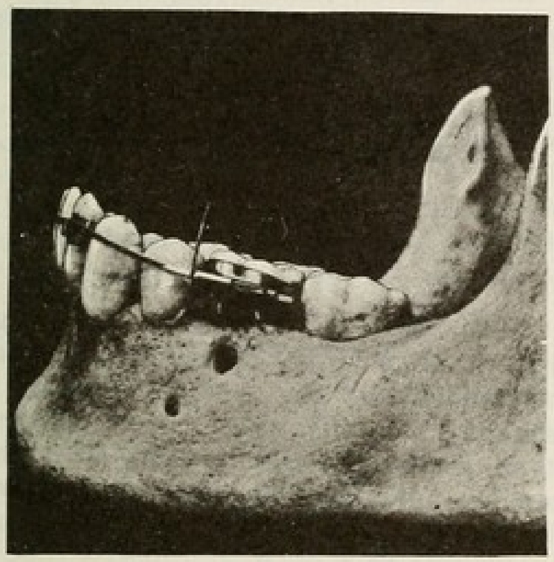
FIG. 4.



The Tiny ribbon arches are formed from segments of required length cut from bars of Tiny arch material, then bent and shaped to lie passively within the brackets and anchor sheaths in close relation to the teeth. Power from the anchor teeth is exerted through the Tiny ribbon arch by means of delicate metal tangs (G, Fig. 3) .016" square and ¾" long, and soft in temper, one end of each being attached by solder close to an end of the arch, as at X, Fig. 7. One is also shown bent at right angles to the arch in Fig. 5.

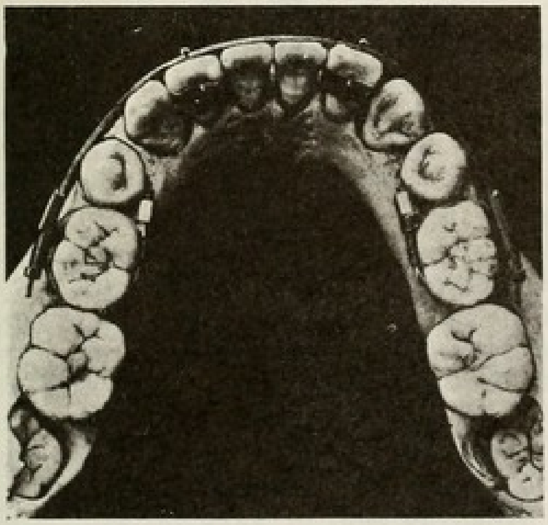
The Tiny clamp and bracket bands, C C and E, Fig. 3, are adjusted in pre-

FIG. 5.



cisely the same manner as are the larger bands, but are easier to shape to close adaptation because of their reduced width. The important advantages to be

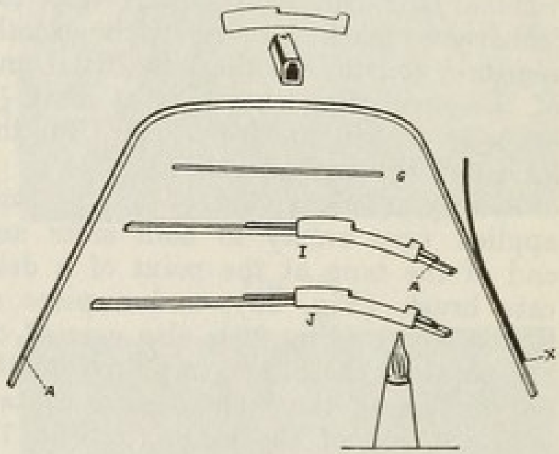
FIG. 6.



gained in the use of clamp bands for anchorage and the various steps to be followed in their adjustment have all been carefully described and illustrated in an article by the author published in the DENTAL COSMOS for October and November, 1920, which should be most carefully reviewed.

The anchor sheaths, F F, Fig. 3, and I and J, Fig. 7, are very delicate and curved to lessen interference with the cheeks. After the clamp bands have been fitted to the teeth the sheaths are attached to them by solder at the exact angles required. A portion of the outer wall of the sheath is cut away (I and J, Fig. 7) and its inner surface is double-grooved as shown in the end view, Fig. 7. When in position on the teeth the inner groove accurately engages the Tiny ribbon arch and the outer one the tang wire, the unattached or mesial end of

FIG. 7.



the latter being drawn forward, bent upward, as in Fig. 5, firmly clinched and the excess trimmed off, as in Figs. 4 and 6.

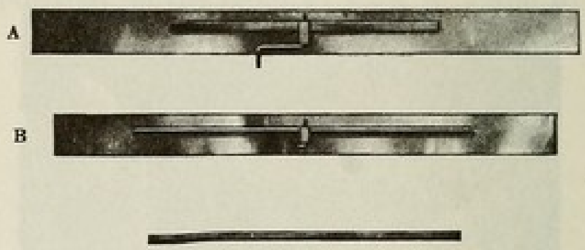
When in position on the teeth the ends of the Tiny ribbon arch must project distally 3/32" or more beyond the ends of the sheaths (and of the tangs), and, in order to locate the positions at which the tangs should be attached, the arch wire, while seated in the sheaths and brackets on the teeth, is plainly marked transversely on its outer sides at the points at which it emerges from the sheaths and then removed from the teeth, when it will present the appearance shown at A, Fig. 7. The tang, G, Fig. 7, is then slipped through a detached duplicate sheath kept for the purpose of supporting the tang and arch in correct relations while being united by solder, then the arch is slipped through and both moved until the posterior end of the tang rests flat against the arch and registers with the mark previously made on the arch at A, I, Fig. 7, with the distal end of the sheath slipped forward about $\frac{1}{8}''$, as also shown. The sheath thus securely supports both arch and tang in the exact relation desired in readiness for the flux, solder and soldering flame, J, Fig. 7.

Before proceeding further the work should be inspected with a glass and, on the following points, carefully checked up, noting, first, whether the end of the tang rests flat on and in close relation to the arch; second, whether the tang is in the exact center of the arch; third, whether the end of the tang and the transverse mark on the arch exactly register; fourth, whether the distal end of the supporting sheath is at least $\frac{1}{8}''$ mesially to the transverse mark on the arch and the end of the tang.

A very small amount of flux is then applied very evenly to both sides and end of the tang at the point of a delicate brush (Fig. 20), and a piece of solder No. 1 (Fig. 20), also carried on the point of the brush, is placed on the flat surface of the arch in close contact with the end of the tang, (J, Fig. 7). When all is perfect, heat from the flame of an alcohol lamp is slowly applied to the *sheath only* and the temperature carefully and *very slowly* raised to the melting point of the solder. Direct contact of the flame with the projecting ends of arch and tang must be avoided and extreme care taken to heat both *slowly, evenly* and *equally,* as manifested by their color.

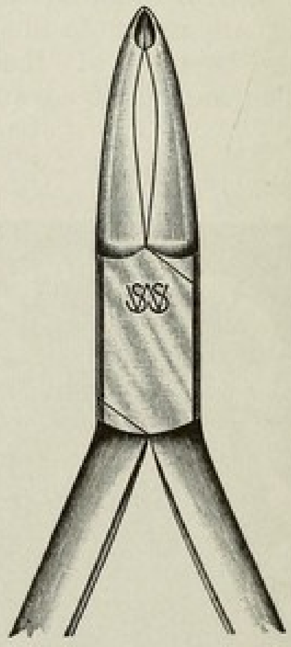
The work is now allowed to cool slowly and, after the removal of the sheath, is deoxidized. It is now again inspected with the glass and, if the foregoing steps in the operation have been followed, it will be found that the solder has closely and firmly united the tang to the arch for about 1/32″, as shown at X, Fig. 7, with no surplus solder to interfere when the arch is re-seated in the sheath of the anchor band. However, before re-seating, the ends of the arch should be inspected and, if found to project more than 3/32″ beyond the end of the tang, the excess should be cut off and the ends smoothed and evenly beveled.

FIG. 8.



The arch is now inserted in its original position in its sheath and bracket attachments on the teeth, into which it should slip easily without binding, and then secured in the brackets with the smaller, or standard, lock pins shown in Fig. 8.* The anterior projecting end

FIG. 9.



of the tang is now grasped by the beaks of pliers, drawn straight forward, and,

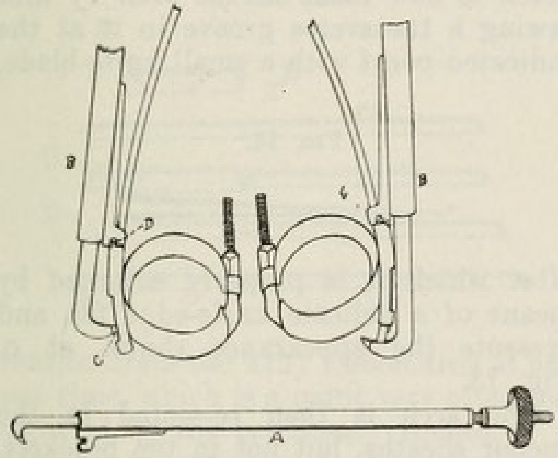
* Two sizes of lock pins are now furnished by the manufacturers. The smaller or standard size must not be confused with the larger, nor the attempt made to use them interchangeably. The use of the larger will be described later.

while steady tension is maintained, bent upward and at right angles to the sheath, as in Fig. 5, then cut off even with the upper margin of the sheath, as in Figs. 4 and 6, by means of the pin cutters, Fig. 9, thus clinching the tang and exerting gentle tension on the teeth.

THE ANGLE-ATKINSON POWER-JACK.

After being thus worn for a few days, tension may again be exerted by means of the Angle-Atkinson power-jack designed for the purpose, A, Fig. 10, (also shown greatly enlarged at B B, Fig. 10). One end of the shaft of this instrument has the form of a hook, on the inner surface of which is a cup-like depression

FIG. 10.



designed to engage the protruding end of the arch. Just anterior to the anchor sheath the arch engages the fork in the flange of the power-jack which projects at right angles from the sheath enclosing the threaded shaft of the instrument, and at the same time the clinch of the tang engages the inclined perpendicular groove in the flange projection. Now while the power-jack is firmly supported in this relation the thumb-screw at the end opposite the hook is tightened, thus moving the arch and tang through the anchor sheath and automatically reclinching the tang to hold the arch in this new position of tension, as at E, Fig. 10. The surplus end of the tang is then again trimmed off. It will be seen that the power is thus under excellent control.

Care must be taken to support and operate the power-jack steadily and firmly and not to exert too much force with it, never causing a greater movement of the arch than just enough to occasion a "snug feeling" on the moving teeth in accordance with the well-known rule.

In like manner power is re-applied from time to time, as required, until the

FIG. 11.

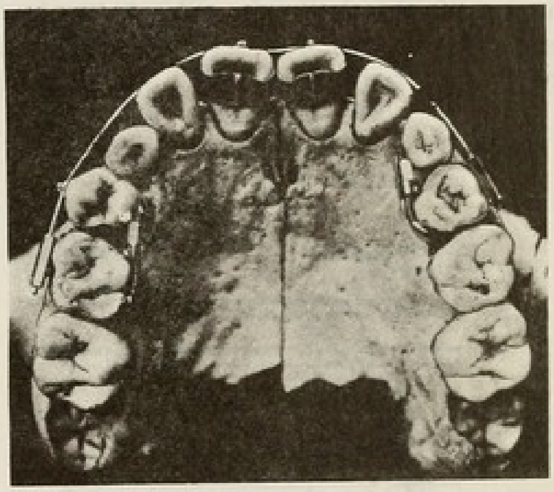
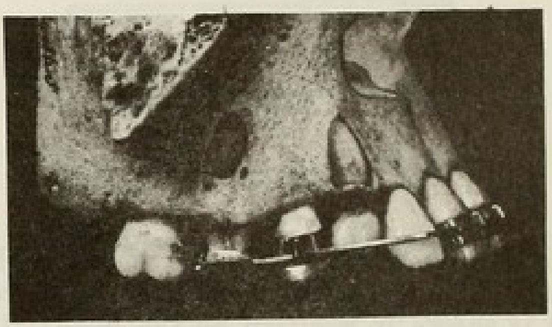


FIG. 12.



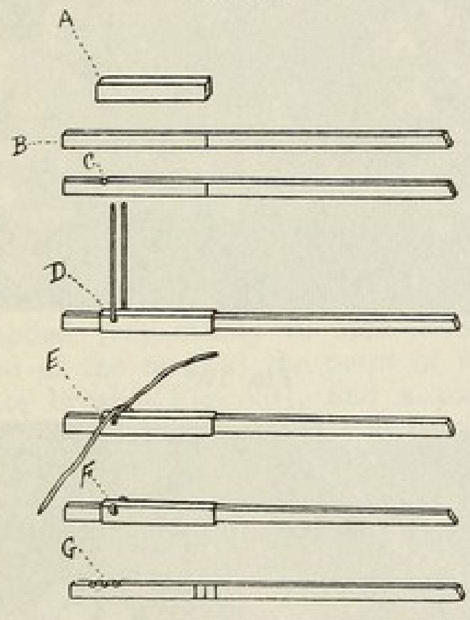
distally projecting end of the arch has reached the distal end of the sheath, when the *point* of the hook of the power-jack may be engaged with the end of the tang through the cut-away portion of the anchor sheath, C, Fig. 10, and further tension from the arch continued, as before, until the distal end of the tang has reached the distal limit of the anterior portion of the outer wall of the anchor sheath. Thus ample range of arch adjustment has been provided for, with ample power, direct and under fine control, from the firmest stationary anchorage.

If the round arch is to be employed with this form of anchorage attachment, the same directions will apply for attaching and operating the tang.

RECTANGULAR SHEATH AND KEY ADJUSTMENT.

Another means for engaging the distal ends of the Tiny ribbon arch with the anchor bands and applying power is by means of the author's delicate rectangular sheath, D D, Fig. 3, and key. This sheath is but 5/16″ in length and

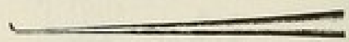
FIG. 13.



accurately engages the end of the arch wire as shown in Figs. 11 and 12, where it is shown in position on the teeth. It is provided with a key-hole near its upper distal end, A, Fig. 13. This delicate hole passes transversely through the side walls of the sheath and forms a round notch or groove in the inner, upper wall of the sheath. A corresponding groove later to be formed in the side of the arch registers with it, completes the key-hole and accommodates the key which effectually prevents the mesial or distal movement of the arch.

It is necessary to locate the notch in the arch with accuracy and this may be easily accomplished. The clamp and bracket bands having been carefully and accurately fitted to the teeth in the usual manner, with the sheaths properly aligned and firmly soldered, the Tiny ribbon arch bent to lie passively in the desired relations to the teeth and in proper bracket and sheath connections, all as shown, two marks are distinctly made on the arch by means of the smallest right-angle exploring instrument, Fig. 14, one within the key-hole and the other transversely to the outer surface of the arch just anterior to the end of the sheath, the latter to aid later in registering the notch in the arch with the notch in the sheath when the key is inserted. The arch is now removed from the teeth when it will present the appearance shown at B, Fig. 13. The notch is now made in the arch by first sawing a transverse groove in it at the indicated point with a small knife-blade,

FIG. 14.



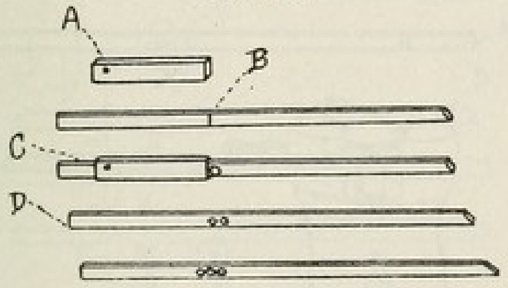
after which it is properly enlarged by means of a delicate knife-edge file and presents the appearance shown at C, Fig. 13.

The arch is then re-seated in the anchor sheaths, but not in the brackets, and when the transverse mark exactly registers with the anterior end of the sheath, the key—a four-inch segment of the smallest ligature wire—is passed through for half its length, its ends drawn straight upward, D, Fig. 13, crossed, as at E, drawn tight and cut off with the pin cutters, Fig. 9, close to the marginal corners of the sheath, as at F, Fig. 13. One of the strongest mechanical principles of fixation is thus employed. The arch is then seated in the brackets and secured by lock pins in the usual way, and allowed to remain passive as long as desired.

To extend the arch mesially and thus exert force on the teeth to be moved the keys and pins are removed, the arch raised from the brackets, slid forward in the sheaths the desired slight distance and carefully re-marked close to the anterior end of the sheath and through the key-hole, as before. It is then removed from the teeth, re-notched and re-seated in the sheaths, but not in the brackets until after the keys are inserted, also as before, the last-made mark anterior to the sheath always being the guide for registering the new notch in the arch with the key-hole in the sheath.

The arch is now sprung into the brackets and re-pinned, as before, even, direct pressure from its elasticity being thus re-exerted on the moving teeth. In the same manner, or by additional marks and notches as at G, Fig. 13, the arch is extended from time to time, as required. It is a mistake to greatly increase the

Fig. 15.



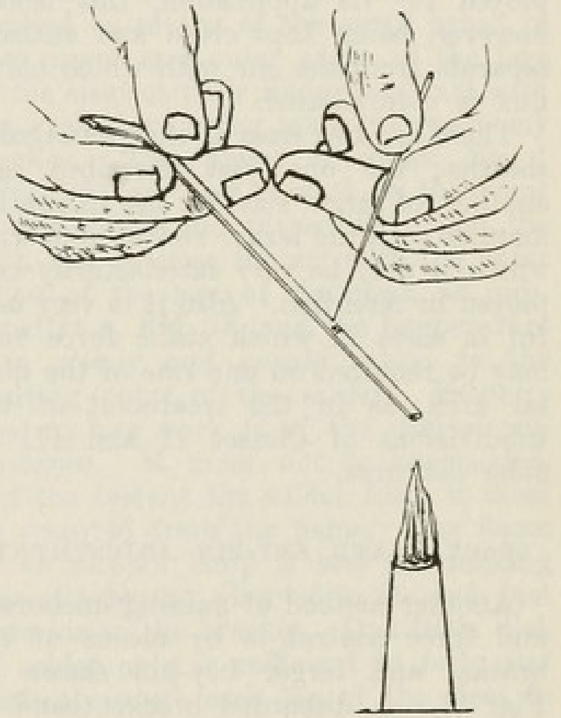
tension from the Tiny ribbon arch at any one time, which is a point very often lost sight of by the beginner. Indeed, it is not always necessary to renew pressure on both sides of the dental arch at each visit of the patient but is usually better to alternate, extending the arch and increasing the tension on one side at one visit and on the other at the next, and so on.

Very positive force control may be gained with this very simple type of mechanism, but it should be obvious that accuracy is required in its use. However, carelessness and inaccuracy have no place in real orthodontia.

RECTANGULAR SHEATH AND LUG ADJUSTMENT.

Another method of extending the arch in the use of this same sheath, in which the key is dispensed with and little lugs of metal used instead, is illustrated at C, Fig. 15. The most suitable form of lugs is the little disks of hard solder, No. 2, shown in Fig. 19. They are attached with minute pieces of jeweler's soft solder and the usual muriate of zinc flux to the side of the Tiny ribbon arch just anterior to the sheaths against which they are to bear, the position at which each is to be attached being indicated by a transverse mark on the arch at the anterior end of the sheath, B, Fig. 15, like those to indicate the registry of the

Fig. 16.



notch in the arch with that in the sheath in the key method.

As it becomes necessary to extend the arch in order to continue tension on the moving teeth these disks are moved distally on the arch the required slight distance by the point of a needle while the solder is in a molten state, Fig. 16. Or those unaccustomed to performing this operation may accomplish the same result in extending the arch by attaching an additional disk of solder just posterior to the one originally employed, as at D, Fig. 15, and, by repeating these attachments, continue the extension of the arch as much as required.

It should be needless to say that very much less heat is required to melt the soft solder than is necessary for hard solder, only the most delicate flame from an alcohol lamp being employed and the temperature raised *very slowly,* otherwise the solder will either be thrown off or burned. Of course the surfaces to be united must be very clean and bright, but the strength of the union when thus properly made is ample and the color and temper of the metal unchanged. Only the most minute pieces of soft solder should be used and a brush similar to that shown in Fig. 20 employed for its application, this brush, however, being kept clean and entirely separate from the one with which borax flux is manipulated.

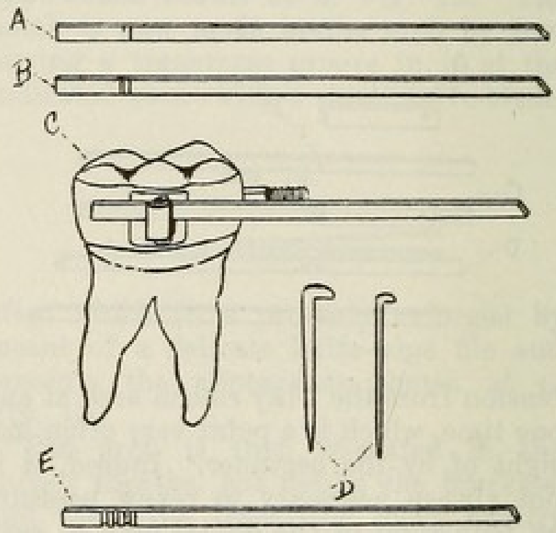
There are two sizes of the rectangular sheaths; the one just described and another, of larger size, for use in similar manner with the larger ribbon arch with which it may be very satisfactorily employed in retention. Also it is very useful in cases in which static force only may be required on one side of the dental arch, as in the treatment of the subdivisions of Classes II and III in older dentures.

BRACKET AND KEY-PIN ADJUSTMENT.

Another method of gaining anchorage and force control is by means of the bracket and larger key-pin shown in Fig. 17. A discarded bracket band of larger size is trimmed down, leaving only the bracket and the reinforced portion of the band. This is attached either by hard or soft solder to the anchor band as in C, Fig. 17, the anchor band adjusted to the tooth and the arch engaged within the bracket and marked transversely both anterior to and within the pin groove in the bracket, as at A, Fig. 17. It is then removed and a transverse groove sawed in it by means of the blade of a small knife at the point indicated within the bracket, the groove then enlarged to a depth of about .005″ with a knife-edge file, as in B, Fig. 17, the arch replaced within the bracket and moved until the transverse mark exactly registers with the anterior side of the bracket. The large pin, which is .004″ wider than the standard pin, is then inserted in the bracket, by its additional width engaging the groove in the arch, then firmly clinched and cut off, the same as in the use of the pin of standard size. The comparative widths of the two pins are shown at D, Fig. 17. In order to extend the arch, additional notches and grooves are formed, as above described, and shown at E, Fig. 17. Care must always be taken to form the groove accurately and especially not to unnecessarily weaken the arch by making it too large.

This is also a very simple, convenient and effectual way of maintaining the position of a tooth in its desired loca-

Fig. 17.

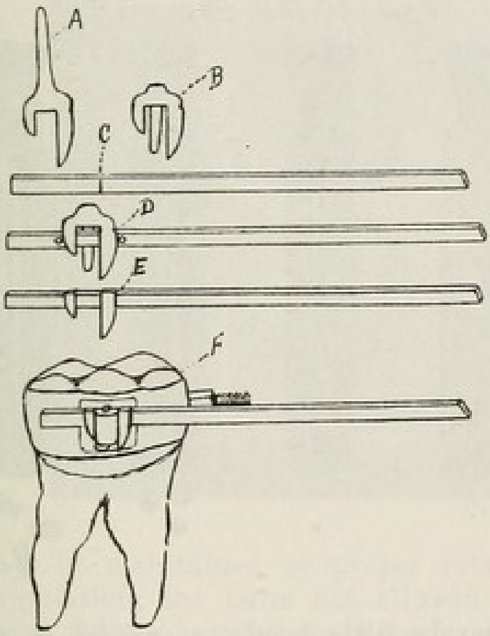


tion with the arch, as occasion may require, especially during the treatment of older dentures. For example, if two separated central incisors have been drawn together, one or both may be keyed into and thus retained in their correct positions while other movements are being performed. Or they may be effectually retained by being so keyed to a segment of the arch. Occasions for other adaptations of the principle will often arise in practice, but we would emphasize that the use of the two sizes of pins must not be confused. If the attempt is made to force the wider pin into the bracket when the arch is not grooved (in which case, of course, the narrower pin only should be used), the bracket may easily be ruined.

BRACKET AND CLEAT ATTACHMENT FOR STATIONARY ANCHORAGE.

Another way of gaining stationary anchorage is by the addition of the new form of cleat, shown in Fig. 18. To properly locate the cleat on the arch the latter is marked transversely just anterior to the bracket attached to the clamp band, as before, and is indicated at B, Fig. 18. The tang of the cleat, A, Fig. 18, is bent as at B, forward or backward according to the side of the dental arch on which it is to be used. The cleat is then slipped on the ribbon arch and the inner edge of its anterior leg made

FIG. 18.



to register with the transverse mark on the arch, the tang effectually securing the cleat in this position while it is being attached to the arch by solder. The notch in the cleat, D, Fig. 18, is for the purpose of indicating the correct perpendicular relation of cleat to arch. When in correct position this notch should exactly register with the highest point, or crest, of the curve of the upper edge of the arch.

It is of the utmost importance that accuracy be observed in each step in attaching the cleat. First, the transverse mark on the arch must be correctly located; second, the tang of the cleat must be properly bent so that it will grasp the arch and hold the cleat evenly, accurately and steadily in contact with the flat surface of the arch; third, the inner edge of the anterior leg of the cleat must accurately register with the transverse mark on the arch; fourth, the notch in the cleat must exactly register with the crest of the curve of the upper edge of the arch. The work should be inspected with a glass to ascertain the accuracy of all these various relations and when they are correct a *very small* amount of flux of creamy consistence should be evenly applied by means of the small brush to both inner and outer edges of the legs of the cleat at their lines of contact with the arch, care being taken to avoid any surplus. Two pieces of solder No. 1 (Fig. 20) are now carried on the point of the brush and placed flat upon the arch and in close contact with the outer edges of the legs of the cleat, as indicated at D, Fig. 18, and the temperature very *slowly and evenly* raised to the melting point of the solder. Properly heating the work is of the utmost importance. It must not be overheated, but the instant the solder fuses it must be removed from the flame. The flame of an alcohol lamp is best for making this attachment, directed to the arch just anterior to the bracket. One little disk of solder only is sufficient to fully and perfectly unite each leg of the cleat to the arch without surplus solder, which would interfere with the seating of the arch in the bracket.

If these steps are accurately followed failure in the operation need never occur, and with practice it becomes a simple and easy operation.

The surplus portion of the cleat is now trimmed off, as at E, Fig. 18, and the arch re-seated and pinned within the bracket as at F. The smaller, or standard, pin only is used in this attachment, the arch not being grooved. It has many very important uses in the treatment of complicated cases.

By studying the mechanisms in these various methods of securing anchorage and force control, it will be seen that all are extremely simple in principle, delicate and compact, and that they yield the firmest possible anchorage, with power ample, very direct and easily controlled. While they are of equal efficiency, the use of the tang wire in the method first described is the most desirable where more frequent or greater extension and adjustment of the arch is necessary, for the reason that the adjustment may be easily and quickly made with the power-jack without removing the arch from its attachments. In such cases as require little adjustment the key method of extension, or that of the solder-disk-lugs, might be more desirable, the latter being more simple and compact than the tang mechanism.

We have tried to make clear the advantages of these various methods, but we would emphasize the fact that nothing can supersede the accuracy and efficiency of power control in the use of the older screw adjustment in cases where greater power and range of movement are required, as in the treatment of dentures of older patients (Figs. 1 and 2). The orthodontist should cultivate a thorough, intelligent understanding of the principles of each method and be able to apply and operate each with equal skill in the special cases in which the particular use of any one of them is indicated, and not limit himself to the use of any one simply because he has mastered it and failed to master the others. Such knowledge and skill only are compatible with the most prompt, thorough and physiological results in treatment.

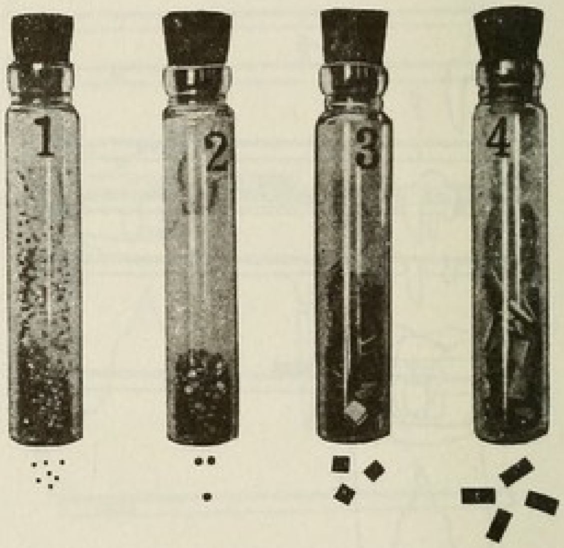
SOLDER, FLUX AND BRUSHES.

It should be clear to everyone that, if a soldered union is to be of proper strength and proportions, just the requisite amount of solder should be used, no more, no less. The time-honored custom of cutting pieces as needed from a sheet of solder, guessing at their sizes, is crude, wasteful of time and material, and the results proportionately lacking in workmanlike uniformity.

At the suggestion of the author the manufacturers now supply solder of proper quality cut with mathematical accuracy to the required graded, standard sizes ready for immediate use. The sizes were arrived at after much careful experimentation by the author and exactly meet the requirements of the specific unions for which each was designed, these including all the unions necessary in the use of the ribbon arch mechanism both standard and "Tiny." Thus not only are the soldering operations simplified and expedited, but unions of the proper mechanical proportions and strength are insured.

Each of the various sizes of solder, Nos. 1, 2, 3 and 4, is contained in a

FIG. 19.

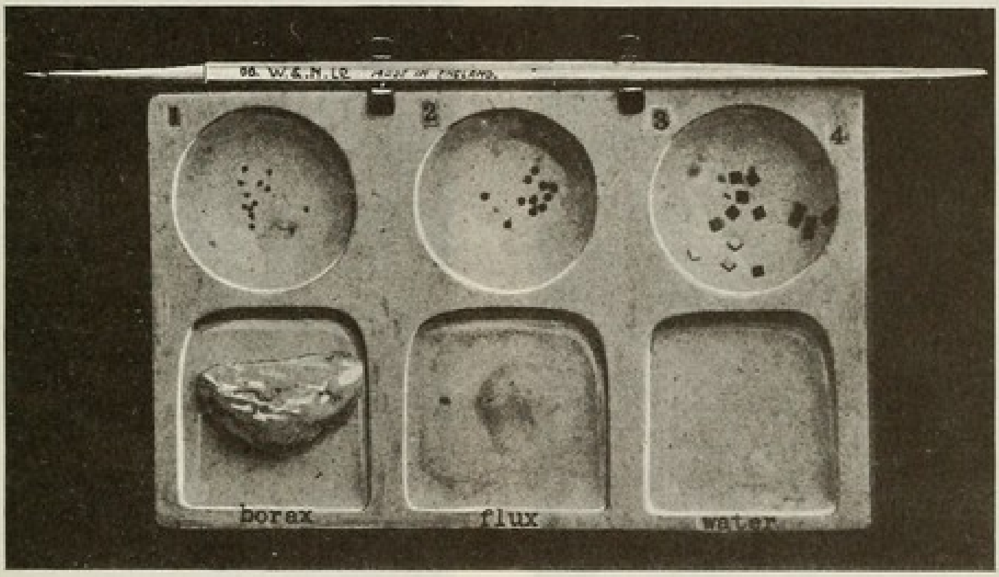


separate little bottle, as shown in Fig. 19. The results of the use of solder in these forms are so satisfactory and the saving of time so considerable that we see no reason why the method should not be adopted by all who appreciate fine, skilful soldering in any line, and the wonder is that solder in these forms was not adopted long ago.

Simple as are the operations of attaching tangs, cleats, lugs, etc., to the arch, it is the height of folly for anyone to attempt them with the usual form of brush employed and the usual careless application of flux, solder and heat. Only with the most delicate brush obtainable, shown in Fig. 20, can the exactly required amount of flux be applied in the exact location required, and we would emphasize the importance of securing this one special form and make of brush, the lettering on the handle of which reads, "00. W. & N. Ld. Made in England." It is such as is employed by painters of miniatures and for painting the figures on the dials of watches, and is amply large for the application of the flux in all necessary orthodontic soldering operations. It is procurable from all dealers in the best artists' supplies. In its use a sharp, round point should always be maintained by proper rotary manipulation, the hairs not allowed to become flattened or broom-shaped. Indeed, all skilful users of brushes of whatever size are observed to maintain this necessary precaution in the use of their brushes.

The little porcelain receptacle shown in Fig. 20 is also procurable at artists' supply houses and is beautifully adapted to holding the various sizes of solder, a lump of crystal borax and a supply of water into which the lump of borax is occasionally dipped while being triturated in its separate depression. The floor of this depression should occasionally be evenly, thoroughly roughened by a disk of carborundum held in the fingers. Just enough borax for each operation should always be freshly ground and the flux thus formed should be of uniform creamy consistence, the greatest cleanliness of brush, receptacle and parts to be united always being maintained. After learning to observe all these precautions and to properly apply just the proper amount of heat, failure or semi-failure in soldering operations should never occur, but beautifully proportioned unions of the greatest strength always result. There is no excuse for carelessness in any soldering operation and in nothing is the result of cause and effect more directly and plainly apparent.

Fig. 20.



The various substitutes for borax flux as above described will satisfy only the careless.

If the reader has thoroughly studied the few simple pieces of mechanism and their combinations and uses as herein described he can not fail to observe their great simplicity and their efficiency in force control, which will be emphasized in his mind as, with increasing skill, he becomes more and more familiar with their use, and those who maintain that the ribbon arch mechanism is complicated, or that it is inefficient for any part of orthodontic treatment, only reflect their own limitations in skill and in their comprehension of mechanics.

In these pages we have sought to

arouse greater interest in the early treatment of malocclusion than has hitherto been manifest, in the hope not only of thus advancing recognition of its great importance, but that, in advocating what we believe to be rational and scientific mechanism for the purpose, the work may be undertaken with confidence and speedily brought to a successful termination. At the same time we would emphasize with all the force at our command that the unnecessary interference with child dentures on the pretext of orthodontic treatment can not be too strongly condemned. The practice of the careless and of the ignorant of placing appliances not positively and definitely required on the teeth of innocent little children, or, having placed them there, even necessarily, causing them to be worn year after year for indefinite periods—conditions by no means uncommon at the present time as all orthodontists know, at least from observation—is little short of criminal, and without doubt should be subject to like punishment with other forms of malpractice. The honest, informed, scientific orthodontist will discriminate between conditions that really require active treatment and those that do not in the cases of the little children brought to him, and will act accordingly. If he is in doubt he will adopt the conservative plan and, keeping the case under observation, note its development for a few months or until the uncertainty is removed.

Fig. 21.

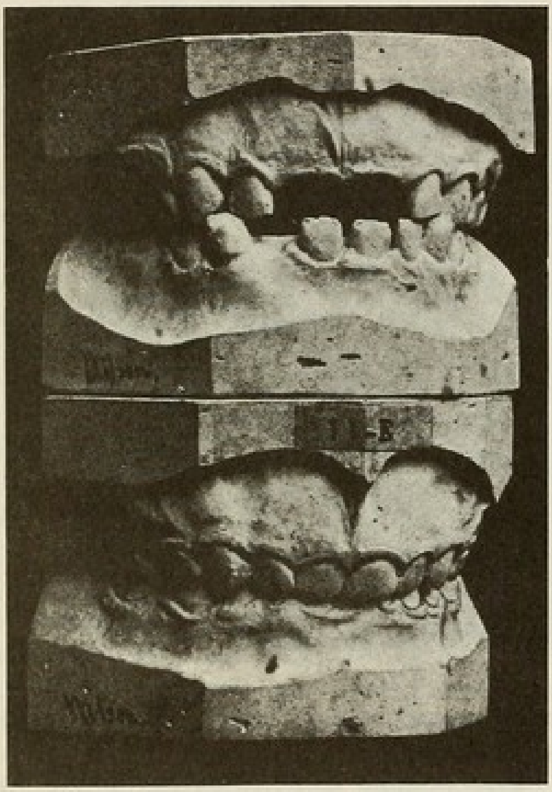
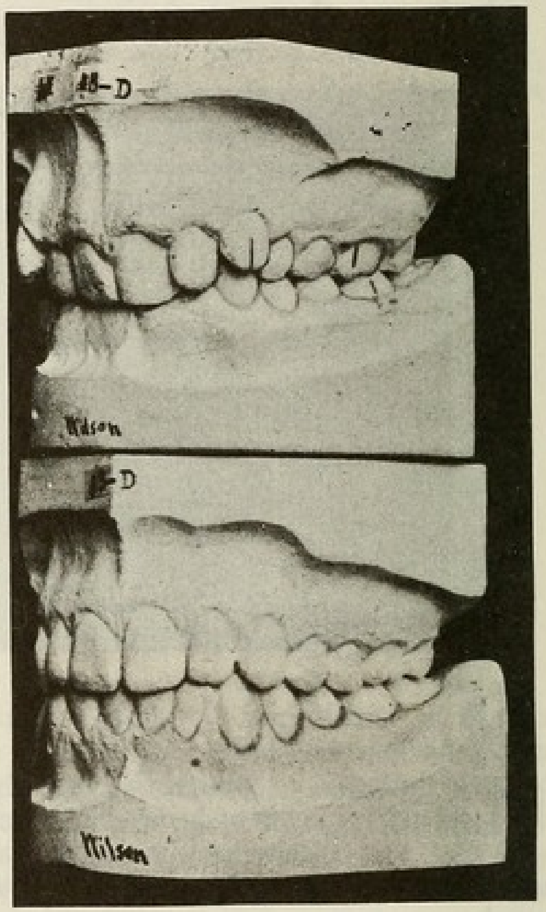


Fig. 22.



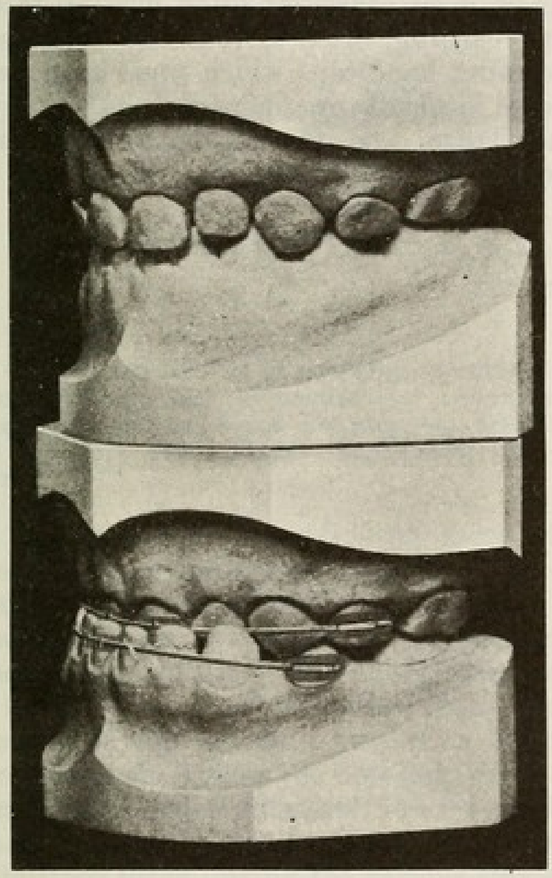
The advantages of early over delayed treatment are well illustrated in the cases shown in Figs. 21 and 22, both of which belong to Class II, Division 2. The lower model in Fig. 21 and the upper in Fig. 22 show the cases at the time treatment was begun, or at the ages of five and fifteen years, respectively.

The malocclusion in the two cases is very similar, due to the similarity of the causes which have produced like perversions of the forces, the results of the progression of which are well shown in the second case. At the age of five years the second case, in all probability, was at approximately the same stage of development as that shown in the first case.

The comparative difficulties in the treatment of the two cases, as here shown, are readily to be comprehended.

The establishment of the proper heights of the teeth (not "by means of metal crowns") is quite as essential in

Fig. 23.



these and all similar cases as is the correction of any other malposition, and is no more difficult, with proper mechanism, than any other correction, if all tooth movements are carried on simultaneously and the available anchorage and reciprocal forces utilized.

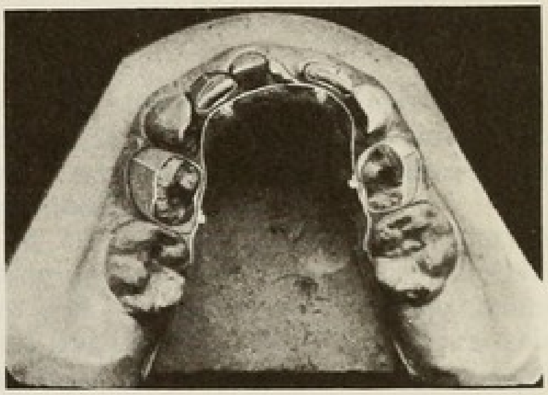
The lower model in Fig. 23 shows a case belonging to Class III in the early stages of development, in which treatment has just been begun. The upper model shows the occlusion after a period of four weeks' active treatment, the case now being ready for retention.

The advantages and ease of treatment of such a case thus early, as compared with the difficulties encountered in the treatment of advanced cases of this type, need no comment.

Of course all the mechanism herein described might be employed on the lingual side of dental arches, one illustration of which is seen in Fig. 24, but we have already made clear the reasons for our belief that *active* orthodontic mechanism should only be employed labially. Conditions may exist under which its lingual wearing might be preferable, but they are difficult to conceive of.

There is one important fact that seems to be overlooked by the advocates of lin-

Fig. 24.



gual mechanism which should be carefully considered, especially in cases in which the dental arches are diminished in size and the teeth crowded and overlapping, as in Fig. 24. This condition has restricted the normal functioning of the tongue, which is therefore more or less sub-normal in size and lacking in normal muscular tone and strength, hence can not exert the force required for enlarging the dental arch nor efficiently combat the force from the lips, which in this case are over-active due to a pernicious lip habit. Now a lingually placed appliance augments the restriction of the tongue, while a properly placed labial arch directly combats the force from the lips, thus indirectly assisting the tongue, and at the same time serving by its mere presence as an automatic "reminder," so to speak, to the lips in overcoming the habit, while performing its chief function of enlarging the dental arch and correcting malpositions of individual teeth.

The true rating of the orthodontist must ever be based on the percentage of his successes; not on the number of cases he treats. As previously pointed out, a very large number of the malocclusions that come to him are the results of perversions of the forces of the denture directly due to abnormal muscular or other habits, usually very early acquired. These, of course, must be overcome, together with the other abnormalities affecting the denture, if treatment is to prove an ultimate success, and reason indicates and experience has proved over and over again that the nearer to the starting point of any habit measures for overcoming it are begun the more hopeful is success in the undertaking, as the great psychologist, James, whose successors are all compelled willingly or unwillingly to pay him tribute, so often emphasizes.

And, finally, to those who love little children—and certainly none other should ever enter the profession of orthodontia—the pleasure of working for so delightful a clientele is very great, as is also the joy and satisfaction of so early, with such comparative ease and with such reasonable hope of real success, restoring to normal, conditions which we know must otherwise often develop into far-reaching, often serious and even deforming handicaps which must soon become difficult or impossible to wholly normalize, and the ultimate effects of which can never be wholly eradicated.

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ORIGINAL COMMUNICATIONS

The Latest and Best in Orthodontic Mechanism*

By EDWARD H. ANGLE, M.D., D.D.S., Sc.D., Pasadena, Calif.

Our success will lie in adapting to our particular needs such principles . . . as have been tried and not found wanting; our failure in visionary experiments.—ALEXANDER HAMILTON.

Members and Friends,—As most of you know, I have been very busily engaged for many months on the development of some new types of orthodontic mechanism, and it is with much pleasure I bring for your consideration today the results of my efforts. Our time is so precious I shall show you now only the refined, perfected mechanism, the result of many changes of form, eliminations and additions made during the various stages of its development. These changes were found necessary in the careful and rigid tests to which the mechanism has been subjected in our clinic in the practical treatment of a large number of cases, the work being done under my closest supervision by students of the usual variations in natural ability and skill. Probably no other orthodontic mechanism has ever undergone a more thorough and severe testing out before being introduced publicly.

In view of the fact that you are all doing such splendid work with the ribbon arch mechanism, and with such manifest satisfaction, it is quite probable that most of you realize I have no light task before me in my attempt to justify the pretentious title of my paper. But if you will give me such careful attention as all true and earnest students of science eagerly accord new and promising ideas, I feel sure that when I have concluded you will agree with me that my title may not be greatly at variance with truth.

Now, orthodontists who are abreast of the times fully realize that in treating malocclusion of the teeth such corrections must be made as will reëstablish the denture as a self-sustaining, self-maintaining unit or organism; in other

* The original draft of this paper was read June 2, 1925, at the fourth annual meeting of the Edward H. Angle Society of Orthodontists, held at Berkeley, Calif. In a revised form it was read before the same society on December 6, 1926, at Pasadena, Calif., and in its present still further revised and enlarged form it was read on June 28, 1928, at the seventh annual meeting of this Society at New London, Conn.

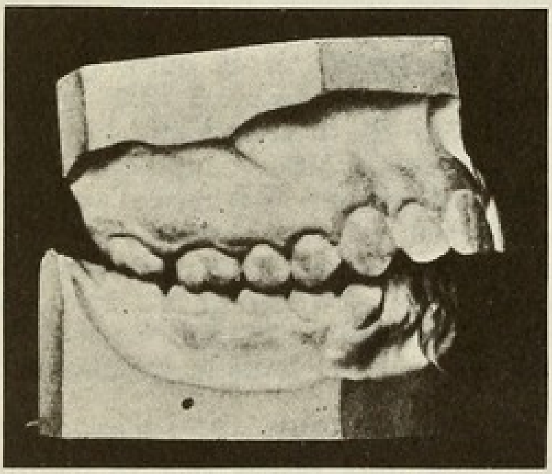
words, that all parts of the denture which exert force and all those which sustain and distribute force must be perfectly balanced, in pairs, in groups and as a whole, for *balance* is the greatest word in orthodontia. It is the law of the successful maintenance of that denture which reaches normal development naturally, and it is the law which must be observed in detail if treatment of an unbalanced denture — malocclusion — is to be successful. These details are as follows:

First, there must be established fully normal proximal contact relations of teeth arranged in arches of normal individual typal form and size;

Second, there must be established fully normal cusp and inclined plane interrelationships; and

Third, and quite as important as the other two, though seeming as yet to be little appreciated, there must be established fully normal upright axial positions and relations of the teeth, if the teeth are to balance with the muscles and sustain and normally maintain the great weight of occlusion.

Fig. 1



To make this last point clear: You all know that in addition to the usual irregular cusp relationships, there is found in a very large percentage of cases of malocclusion a more or less abnormal tipping or leaning forward of many or all of the teeth on either or both sides of one or both dental arches, and often, also a slight bodily drifting forward of their normal positions. These conditions may, of course, be found in cases of all classes, divisions and subdivisions of malocclusion of the teeth. Figure 1 shows a very pronounced illustration in a case belonging to Class II, Division 1.

Now, in the treatment of malocclusion, science and right practice demand the correction of these abnormal leaning positions with insistence equal to that of gaining fully normal cusp relationships. Unless both are corrected, the teeth composing the dental arches will not occupy their *normal, typal, mesiodistal and axial positions* in their respective jaws and be in harmony of position and relation with the bones of the skull and the muscles of the denture. In other words, they will not be in harmony with the line of occlusion which means mechanical balance of the teeth not only in their relations to one another, but to the forces which govern their positions and functions; such relations, in short, as will, through the normal functioning of the denture, stimulate to, or at least toward normal development those portions of the denture the growth of which has been arrested or perverted through lack of proper functioning. On this "hangs all the law and the prophets," and although I pointed out the fact long ago, it cannot be too often emphasized, for only by establishing such relations in treatment can lasting success be attained in any case, as all here present well know.* The large numbers of lamentable failures in treatment, with which we are all so frequently brought into contact and which are rapidly bringing orthodontia into disrepute with the best elements in dentistry, the laity and medicine, are clearly the result of not establishing these vital relations of the teeth and their governing forces. Analysis of these failures makes clear the fact that the essential and fundamental principles of diagnosis and practice are not taught or comprehended as they should be or they could not be so widely

* "Malocclusion of the Teeth," sixth and seventh editions.

and flagrantly disregarded, or such totally inefficient mechanisms employed in treatment as those we too commonly see. Neither would such weak and childish excuses be offered in defense of failures as are so commonly recorded in the literature. The review of many recent articles is but the review of pages from the "dark ages" of orthodontia—from forty to sixty years ago. Indeed it would seem that the writers of many of these articles do not even suspect the beginning of an orthodontic renaissance. All of which but leads up to and emphasizes the need of better, broader, more thorough, more scientific understanding and teaching of orthodontia, for laws to protect and govern its teaching and practice (of which none now exist), and for mechanism fully capable of meeting the highest demands of orthodontic treatment.

As what I hope may prove a helpful measure toward one of these ends, I am offering you the new mechanism which I feel sure will be found to be more practicable and efficient for the purpose intended than anything previously available, at least by those who are not "in a rut and contented," and truly helpful to those who are earnestly seeking the best.

Now, as I know, all of the various necessary tooth movements in the treatment of any case are not only possible but very practically possible in the use of the ribbon arch mechanism. And I also know that with it most of you are daily attaining very commendable results. Yet I shall hope to prove to you, in a description of the new mechanism and of the results of treatment in its use in a large number of cases which we shall show you here in the clinic, that with it the desired results, above enumerated, may be obtained with much less expenditure of time and with less inconvenience to yourselves and your patients than in the use of the ribbon arch mechanism or any other mechanism alone. This because of the greater efficiency of the new mechanism, due to the more free and direct expenditure of force and, especially, to the more perfect control of force it affords and its consequent greater conformability to the physiological requirements of the tissues involved in tooth movement.

Most of the clinic patients will be here today so that you may critically inspect the results attained in their treatments by means of this mechanism exclusively. Additional evidence as to the value of the mechanism will also be offered later by others of our members who are using it extensively in their private practices.

Before proceeding, let me state that you who, through much patient effort in following my teachings and writings on the ribbon arch mechanism, together with the more recent writings on the subject by Dr. R. H. W. Strang,* have become masters of that mechanism and are doing such excellent work with it need not feel that it is wholly necessary to change to the new. But those who are really eager to keep abreast of progress, and all who are beginning their life's work in orthodontia, will do well to put forth their keenest endeavors to master thoroughly the principles of the new mechanism and the technique of its proper use. The advantages thus to be gained will be found to be well worth while.

Few of you will be able to realize what a struggle it has cost me to introduce a seeming rival to my own precious offspring, the ribbon arch mechanism. But we are not our own masters. Some invisible hand is always pushing us on to do, or try to do, what it seems we must, not always what we would. Yet, in reality, we shall later see that the new is not truly a rival, but that by their union the two mechanisms may be made harmonious and even coöperative, in many instances to the benefit of both, especially to the ribbon arch mechanism, and that thus our mechanical resources for treatment are widened and strengthened.

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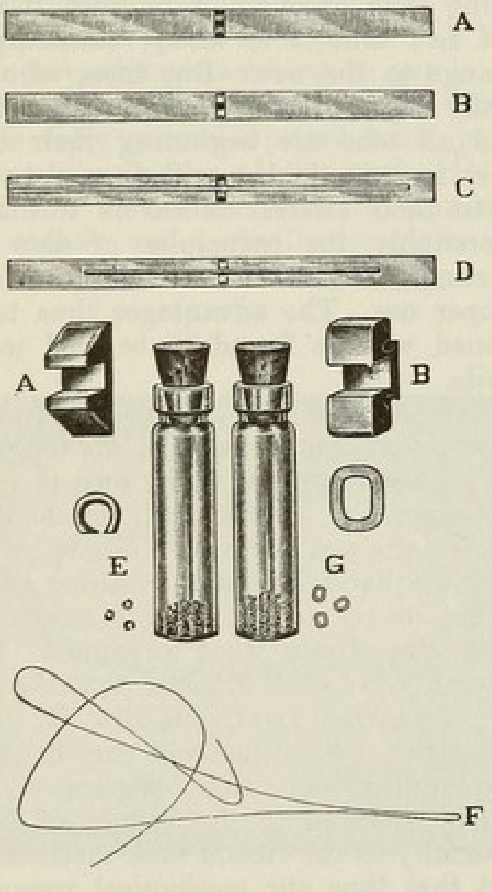
* DENTAL COSMOS, August 1925. The excellent articles by Drs. Allan G. Brodie and M. M. McKenzie, published, respectively, in the August and October 1927 issues of the DENTAL COSMOS, are also strongly recommended to the reader.

Of course when I speak of the ribbon arch mechanism you will understand that I mean it in its true majesty and simplicity, without freak lingual accompaniments with waving antennæ in the form of wabbly "finger" attachments, jiggly anchor attachments, etc., and not placed in upside-down positions on the teeth.

The principles of application and operation of the mechanism, which I shall now describe, are, in the main, along the line of those with which you are already familiar, those of the time-honored labial arch mechanism here made use of in devices of further refinement. In fact, as we shall see, in this

FIG. 2



mechanism are combined most of the best points of all my former types of expansion arch mechanism, that is, the arches E and B, the arch with pin and tube attachments, and all forms of the ribbon arch mechanism, and, besides, it has many other distinct advantages peculiar to itself.

Figure 2 illustrates all of the various parts of the new mechanism.

A shows a band which is 1/8 inch wide, 1¾ inches long, and .004 inch thick, with a bracket brazed to the center of its labial surface. The bracket is made from a solid block of metal and has a slot cut horizontally across it midway of its length. The outer ends of the bracket are beveled from the slot to the edges of the band. You will note how delicacy and strength are combined in its proportions. It is designed especially for use on anterior teeth, although it may be used in any part of the mouth. This will be known as open-face bracket No. 1.

B shows another band of the same dimensions as that shown at A, but bearing a somewhat different type of horizontally slotted bracket, the portions of the bracket above and below the slot, instead of being beveled, forming overhanging flanges or wings. It is designed for use on buccal teeth and will be known as open-face bracket No. 2.

The slots in both brackets are for the reception of metal arches, the active or power members of the mechanism.

C and D show the two types of bracket bands, seated within the brackets of which are segments of two types of elastic arch material of which the arches are to be made, the form of arch used to be determined according to the requirements of particular cases. The one shown at C is rectangular in form and made from a bar of metal of the same material as that of which the tiny ribbon arches, used on deciduous and mixed dentures, are made. It is carefully drawn to the dimensions of exactly .022 inch in thickness and .028 inch in width, and it most accurately fits the slots in both brackets. That at D is round and but .022 inch in diameter, of the same material as that you have been using for spurs, retention and, occasionally, for arches in the tiny ribbon arch mechanism.

The two types of arch shown at A and B, Fig. 14, are interchangeable in the two types of brackets.

It will be noted that the rectangular

arch is applied *edgewise* to the brackets instead of sidewise or flatwise, as in its use in the ribbon arch mechanism. For this reason it will hereinafter be designated the edgewise arch, to distinguish it from the ribbon arch which also is rectangular in form. Used in this novel manner, the arch is more delicate and graceful in appearance, besides having greater power under certain conditions and far greater elasticity or range of operating force under others, as in widening dental arches, effecting some forms of root movement, tipping teeth into their correct upright axial relations, etc.

Since the strain upon both types of band comes exactly in the center of the band, force is exerted equally upon it in all directions and the use of a band narrower than heretofore required, or one but one-eighth of an inch wide, is made possible.

The arches are locked in the brackets by means of wire ligatures operated in a new manner which will later be described.

E shows diminutive staples of precious metal, to be attached by solder to bands, arches, etc., for the better control of power for tooth movement. Their function is to act as a novel means of attaching the band to the arch through the medium of the ligature, the ligature having the double function of securely holding the arch within the slot of the bracket and at the same time exerting force, through the staple, for the movement of the tooth, as shown in Fig. 26.

The quality of the metal of which the staples are made, as well as their size and bore (the latter being .015 inch), has been carefully worked out to best meet the greatest variety of needs. If of larger bore or heavier material, their bulk would make their use impractical in many instances.

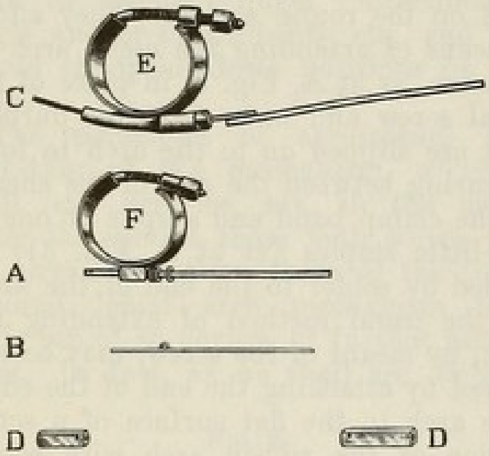
The ligatures are of two dimensions, .010 inch and .015 inch, and are made of a special quality of brass to afford the maximum toughness and softness. The one of larger diameter is looped in the center, as at F, Fig. 2, and A, Fig. 23, and the loop only, the portion used, is gold-plated, thus overcoming the occasional discoloration of the ligature in the mouth.

G illustrates minute washers .025 inch in thickness. They accurately fit the rectangular arch and are also to be used on the round arches. They afford a means of extending the metal arch on occasion, as at A, Fig. 3, in place of the usual screw and nut. For this purpose they are slipped on to the arch to form a bearing between the end of the sheath of the clamp band and a spur or one of the little staples (as at B, Fig. 3), attached by solder to the end of the arch. Or the usual method of extending the arch, by means of the screw, may be employed by attaching the end of the edgewise arch to the flat surface of a screw section of the ribbon arch with solder in a lapped joint, as at C, Fig. 3. But the very simple, delicate and compact new method described will surely be greatly appreciated by all who learn its use. Of course the washers can only be applied to the arch outside the mouth or on occasions when the arch is removed from the mouth to make necessary changes in its form. Extension without its removal may, however, be easily effected by throwing a loop of the ligature wire about it, between the end of the sheath of the clamp band and one of the washers, twisting the ligature tightly and cutting off its ends, thus improvising a washer.

E and F, Fig. 3, represent two of my well-known anchor clamp bands. Since the parts of the new mechanism are very delicate, the lighter form of band, that shown at F, will probably be preferred by the majority of users, but the use of the heavier, standard form, shown at E, will be continued by many, especially in the treatment of mature dentures.

These bands as now supplied by the manufacturers have a rolled gold plate over the external surface of the flat portion of the band. Although this supposed improvement is preferred by many, my own preference is for the properly constructed, electro-plated, four-piece, nickel-silver band which I introduced long ago and which has since been copied and satisfactorily used the world over. I prefer it for the reason that there is no other known metal in which strength and great adaptability are so suitably

FIG. 3



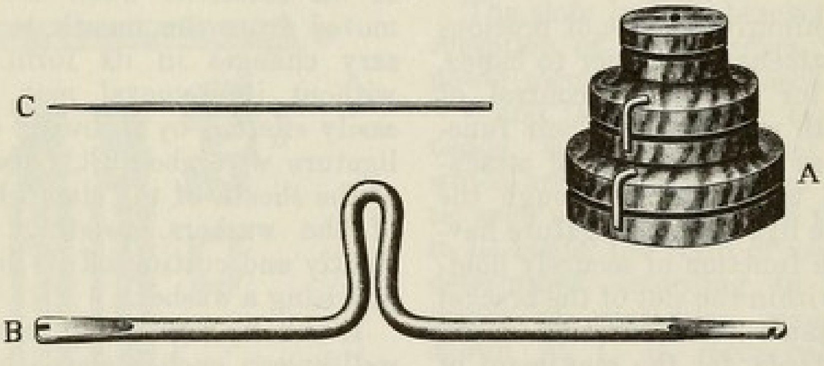
combined for the purpose of a clamp band, or that can be made to fit the tooth so accurately and adhere to it so closely and thus offer the firmest attachment and greatest resistance to accidental loosening. It also excels in another well-known particular, namely, that it is more kindly tolerated by the enamel of the teeth than any of the precious metals. The principal objection to its use is that in some mouths it undergoes disintegration and loses strength. This it does not do, however, unless it is worn for long periods of time or is injured by being overheated. If properly used in cases the treatment of which is conducted with physiological rapidity, there is no better band. The band has also recently been improved and refined in other details which make it easier to apply and permit its closer adaptation to the tooth.

In Fig. 3, D, D represent the tiny and standard rectangular sheaths, to be attached to anchor clamp bands for the reception and support of the ends respectively, of the tiny and standard rectangular metal arches.

In addition to my regular standard types of instruments for assembling, adjusting and operating orthodontic mechanism, three new ones of special forms are indispensable in the use of this new mechanism. Two of these are for shaping the metal arches and the third is used in making soldered attachments.

A, Fig. 4, illustrates one of them, the arch former, especially necessary in shaping the edgewise arches. It is well known that in bending, edgewise, metal of ribbon form in any ordinary way, it is liable to injury through crimping or buckling, but I have found that if bent in an accurately fitting groove on a circular form this may be avoided and a perfect edgewise bend easily effected.

FIG. 4



The instrument illustrated (at A), is made of very hard material and has step divisions of three different sizes. On each division is a groove into which the arch bar accurately fits edgewise as it is firmly held and slowly fed into the groove while the instrument is turned with the fingers. Either an even peripheral bend or a slightly dished bend may be given the metal, according as it is fed into the groove exactly parallel to the walls of the groove or made to lean to one side or the other. To give it the latter form is sometimes desirable. The medium grooved division is the one to be used in bending the arch when spring-tempered; the largest, if the temper has been drawn. The smallest is for accentuating the bends in the metal arch in the region of the cuspids, later to be described.

Special, shorter bends in the arch, very necessary and later to be fully discussed, are made by means of the second new instrument, the arch bender, shown at B, Fig. 4. This is a form of key-wrench, both ends of which are flattened, accurately grooved and carefully tempered. One end accurately fits the tiny rectangular arch in its edgewise diameter and the other in its sidewise or flatwise diameter. In its use the bends may sometimes be made while the arch is in the mouth, though it will generally be used on the disengaged arch outside of the mouth.

In the technique of modern orthodontia great advantage is often to be gained by changing the positions of small attachments previously soldered to bands or arches. We have long been doing this by means of a common sewing needle, holding it in the fingers and using its point to push gently or tease the delicate attachments to another position while the work is held in the flame and the solder is in a molten state. Many of you, as I know, have developed much skill in this delicate, helpful operation. Yet in performing it we have all been annoyed by the steel needle losing its temper in the heat and becoming bent or burnt and useless. I have recently substituted tungsten metal for steel for making the needle and I am delighted with it, for it offers two splendid advantages over the steel needle. First, its rigidity is not affected by heat, and second, molten solder rarely coheres to it. The manufacturers have consented to supply us with tungsten needles (the third new instrument), one of which is illustrated at C, Fig. 4.

The manner of engaging and distributing power from the edgewise arch through the simple open-face bracket and ligature attachments in the exact amounts and directions required for the necessary movement of each tooth is easy to understand. But if all the various required movements are to be effected in a physiological manner, that is, in the shortest period of time consistent with normal activity of the cells of the structures operated upon, it will be necessary that skill and judgment in the technique of adjusting and operating the mechanism be developed. And where this technique accords in general with that of the ribbon arch mechanism, there are some radically new and distinctly different technical operations, perfect familiarity with which must be gained if the mechanism is to be used to the best advantage.

FITTING PLAIN AND CLAMP BANDS

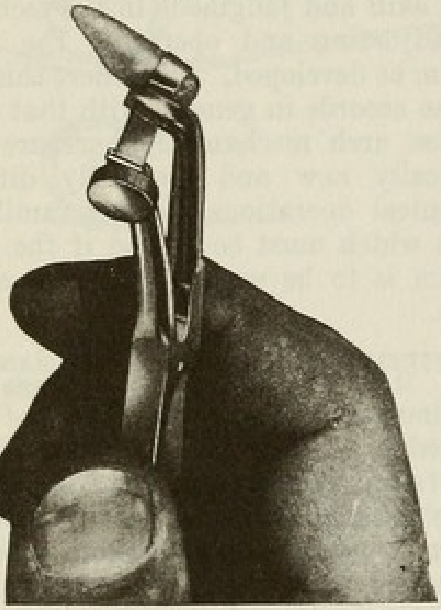
Since the making and fitting of plain brazed bands to incisors and cuspids, as well as fitting the anchor clamp bands, have become such necessary, common operations in orthodontia, and since both have been so thoroughly described in my previous writings,* it will not be necessary to do more here than simply refer to those descriptions, except to urge earnestly that they be re-read and carefully followed step by step. But I would again emphasize the great importance of fitting the bands accurately and so locating them on the teeth as to afford the firmest mechanical attachment. I would also call attention to the fact that with the newly improved band-forming pliers, Fig. 5, the narrower plain brazed bands of the new mechanism can easily be made to fit more beautifully and accurately than was ever possible with the wider band material of former mechanisms. In fact, when these narrower bands are placed in the proper manner at the exact points at which they should be placed, they afford the very firmest

* "Malocclusion of the Teeth," seventh edition; "Orthodontia—the Ribbon Arch Mechanism and Some New Auxiliary Instruments," DENTAL COSMOS, October and November 1920; and "Special Mechanism for the Treatment of Deciduous and Mixed Dentures," DENTAL COSMOS, May 1924. (The two later articles have been reprinted in pamphlet form and may be had on application to the DENTAL COSMOS.)

medium of attachment between teeth and active mechanism, besides presenting a not unpleasing appearance.

In fitting the bracket bands it is usually best to bring the bracket into the

Fig. 5



center of the labial surface of the tooth. However, this must not be regarded a rigid rule, since, when there is any conflict between efficiency and appearance, efficiency should always take precedence. For this reason, to effect the rotation of teeth, especially of cuspids and bicuspids, the bracket should be placed toward the more prominent labial or buccal angle of the tooth, and the staple at the opposite labial or buccal angle, as in Fig. 26. In this way the greatest leverage and longest period of activity from the spring of the arch is insured.

Since the harmonious arrangement of mechanism is always more pleasing in appearance than that of mechanism inharmoniously arranged, it is well worth while to give the matter some consideration. For example, the bands and brackets on the central incisors may balance and harmonize as to positions and relations, while those on the lateral incisors should also balance and harmonize with each other, but not necessarily with those on the central incisors. This like relation of bands and brackets on corresponding teeth may be maintained even in cases where one of these teeth needs rotation and the other does not, unless, of course, the position of the second tooth makes the radically different movement of the tooth necessary, when the bracket should be so placed as to give the greatest efficiency.

SHAPING THE TWO TYPES OF ARCHES

Before discussing the technique of making the various finer attachments of this mechanism, let us consider quite carefully the shaping of the metal arches, for it is only in the proper shaping of the arch that "all the honor lies" for effectually awakening the magic power within it to do our bidding in tooth movement.

It must always be remembered, in the use of these arches, that since their attachment within the brackets, that is, between the walls of the brackets, is rigid, the amount and directions of movement of teeth individually and collectively will correspond wholly and completely to the individual and collective bends that are made in them. Now, since each required movement of each tooth is to be clearly discerned in the diagnosis of each case, the degree and direction of each bend in the arches necessary to accomplish these movements can and of course should be made in strict accordance therewith. If not thus made, or if the bending is crude and careless, the movements of the teeth will be erratic and uncertain, whereas, if done painstakingly, at the right points in the arch, to the right degree and in the right directions, as a result of intelligent thought and proper basic technical discipline, the tooth movements will conform therewith and proceed in the exact directions of the desired final positions of the teeth.

Not only may the power to be developed in this edgewise arch be studied logically and comprehended, but I believe that in the use of the arch, as employed in this mechanism, the power, both in amount and direction, may be so directly applied and efficiently controlled as to accord far more truly with the laws of both physiology and dynamics than is possible in the use of any mechanism heretofore employed. And this is my only reason for offering the new mechanism to our science, already overburdened as it is with devices designed for the correction of malocclusion of the teeth.

In the practice of orthodontia, as usually conducted, teeth are moved through what really amounts to a more or less halting, stumbling, floundering, guessing process, due, first, to mechanism so inherently defective that proper force control in its use is difficult or impossible; or, second, to lack of skill and judgment in the control of force in the use of proper mechanism; or, third, to faulty diagnosis and the absence of a clear understanding as to the position to which each malposed tooth should be moved.

Now, it goes without saying that before undertaking treatment of any case there should always be in the mind of the orthodontist a clear conception of the individual line of occlusion. This is only to be gained, first, by very thorough and complete knowledge of the normal human denture, that is, of its growth, development, form and relationships as a whole and of its units, of its structure, functions and the laws of dynamics on which it operates; second, by an extensive general study of malocclusion; and third, by the special study of the malocclusion, muscular and other perversions, and extent of general and special unbalance of parts and functions of the case in hand.

This special study should be thorough, beginning with a consideration of the face and head, front and profile. The sizes, forms and relations of the jaws should next be considered; then the forms and relations of the dental arches and the forms and positions of the teeth, the extent of their variations from normal, in general and specifically, being noted.

In determining the extent of these variations the first molars should always be the starting-points, for the important reason that of all the teeth they are the most constant in and least variable from normal positions in the dental arches and jaws, because of the important functions they are to perform and the very favorable conditions under which they develop and erupt.* Yet notwithstanding their general constancy in taking correct position on eruption, these positions may be modified more or less before, during and after eruption by malpositions which may be assumed by other teeth, either deciduous or permanent, or by the loss or non-development of teeth, especially those anterior to the first molars. These malpositions or the absence of teeth plus the perversions of muscular forces which necessarily accompany these conditions, permit the displacement of the molars from their true, normal, typal positions in the line of occlusion, usually a tipping forward, sometimes a bodily drifting in a mesial direction, and occasionally both. This displacement may be very slight, as in cases belonging to Class I of very young dentures, or it may be extensive in older and very complicated cases. Therefore before attempting to definitely determine the degree of malposition of other teeth, it is necessary to know the extent of mesial or other migration of the first molars from their true positions and, in the mind, to replace them in these positions. To this end must be carefully considered all other relatively basic points in and about the denture, as, for example, the jugal buttress;† the axial inclinations of the permanent cuspids, etc. Clearly visualized in their correct positions, the first molars become the most reliable points or bases in the whole denture from the standpoints of both mechanics and physiology from which to determine the extent of the individual and collective malpositions of all the other teeth, after which, only, can the true diagnosis of the case be made, as well as its classification for convenience.

The truth of these facts has been

* "Malocclusion of the Teeth," seventh edition.

† Klaatsch; also called the "key ridge" by Atkinson.

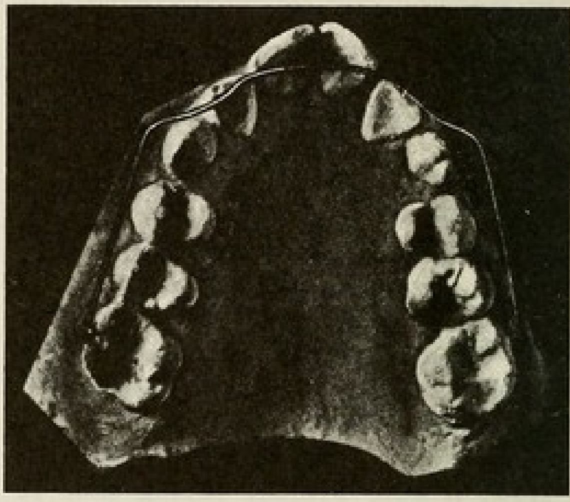
proved such countless numbers of times since they were first enunciated* that, notwithstanding the efforts of the prejudiced and the superficially informed to disprove them, the first permanent molars are now and must continue to be recognized by all who know the growth, physiology and mechanics of the denture, as the chief reliance, not only as a basis for diagnosis, but also as a basis from which to note changes both favorable and unfavorable (if the latter occur) in the positions of the other teeth throughout the whole progress of treatment and retention.

In making diagnoses of deciduous dentures before the permanent first molars have erupted, we must remember that the deciduous second molar is an equally reliable landmark for the deciduous denture, with the permanent first molar for mixed or permanent dentures, as I have elsewhere pointed out.†

All of this careful procedure is in contrast to hasty, immature conclusions and machine-made diagnoses. The latter can never be made successful, for art conforms only to general laws, never to special systems of mathematical measurement, which applies as truly to all branches of the healing art as to other forms of art. And mechanism employed for orthodontic treatment should be such that from the first, in each case, its operation would result in the continuous and physiologically rapid movement of each tooth that required to be moved into its own individual position in the line of occlusion, the ideal and the means of gaining the ideal thus closely coördinating from the beginning to the end of active treatment.

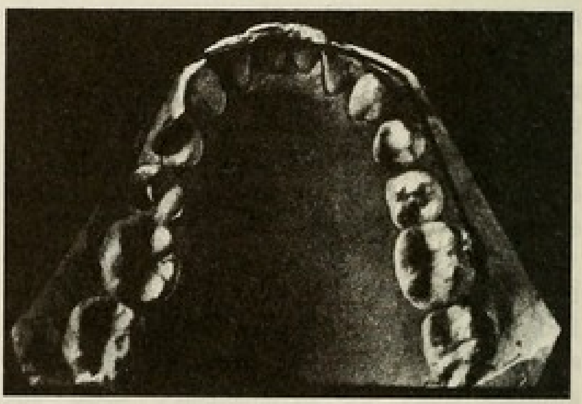
In the use of the mechanism under consideration this is now possible, effected by shaping the metal arches so accurately that from the very beginning of treatment they have *ideal typal* forms, or forms that closely correspond to the desired ultimate forms of the dental arches in each individual case (Figs. 6 and 7). Thus shaped, sprung into and secured in their attachments, they must immediately begin to exert force automatically

Fig. 6



on the malposed teeth, in directions and amounts most favorable for the direct movement of these teeth into their correct positions in the individual, typal line of occlusion. The relation between the activity of the mechanism and the

Fig. 7



typal positions of the teeth is, therefore, not vague and problematical, but closely correlated from the beginning of treatment to its completion. But it will be realized that the shaping of the metal arches must be done *carefully,* and that in size and form they must accord with the required (normal) sizes and forms

* "Malocclusion of the Teeth and Fractures of the Maxillæ," sixth edition, and "Malocclusion of the Teeth," seventh edition.

† "Special Mechanism for the Treatment of Deciduous and Mixed Dentures." Dental Cosmos, May 1924.

of the dental arches in each case, indicated by the sizes and typal patterns of the teeth, the type of the face and skull and the general type of the individual.

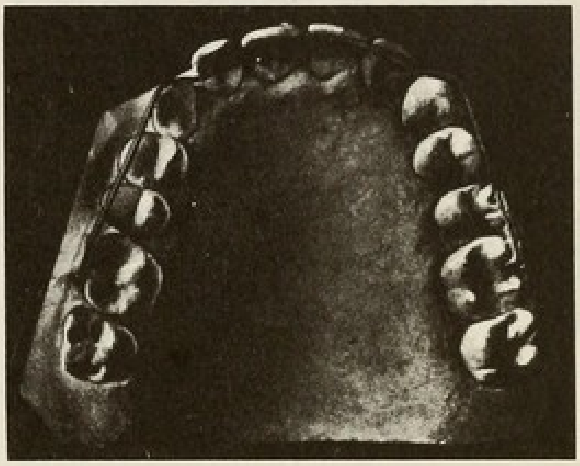
Owing to the delicacy and great elasticity of the two forms of metal arches (round and edgewise) and to the favorable means of attaching them (the horizontal slots in the brackets, and the ligatures), it is usually possible, even at the first adjustment, to spring them into their bracket attachments and enlist their power without materially altering the ideal forms into which they have been shaped, as is unavoidable in the use of mechanism with vertical-slot attachments. In other words, because of the form of the bracket-slot attachments of the new mechanism, the full, free, maximum elasticity of the ideally formed metal arches is accessible from the first for direct distribution to the teeth individually and collectively for their direct movement from their abnormal into their normal positions. These arches will thus naturally be operative over much longer periods before changes in their attachment relations become necessary than will those of the usual types of mechanism. This is especially true in the use of the delicate round arch, and its use is often preferable, particularly in beginning treatment.

Before taking up the technique of shaping metal arches for specific cases so that after tooth movement is completed the dental arches will have the forms desired, that is, the forms in which the teeth will be arranged so as to accord with the line of occlusion of that particular individual, let us consider ideal dental arch form.

Greatly to my surprise I find that there is practically no close agreement among orthodontists as to what constitutes normal of dental arch forms.

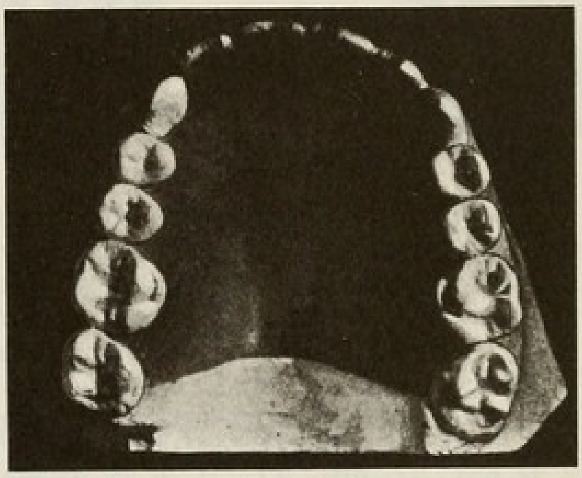
Now, whether they realize it or not, a clear understanding of the correct forms of dental arches, both specific (typal) and in general, and of the correct proximal relations (points of balance) of the teeth in the arches is of the utmost importance to them. If asked to demonstrate the form of a normal upper dental arch, nearly all will give a semi-ellipse, or a horseshoe pattern, with the central and lateral incisors and the cuspids all of the same height and in the same alignment, and nearly always with

FIG. 8



the bicuspids buccally to normal. Indeed, these are overwhelmingly the patterns of upper arches and relations of teeth shown in corrected (?) cases of malocclusion in the current literature and in

FIG. 9

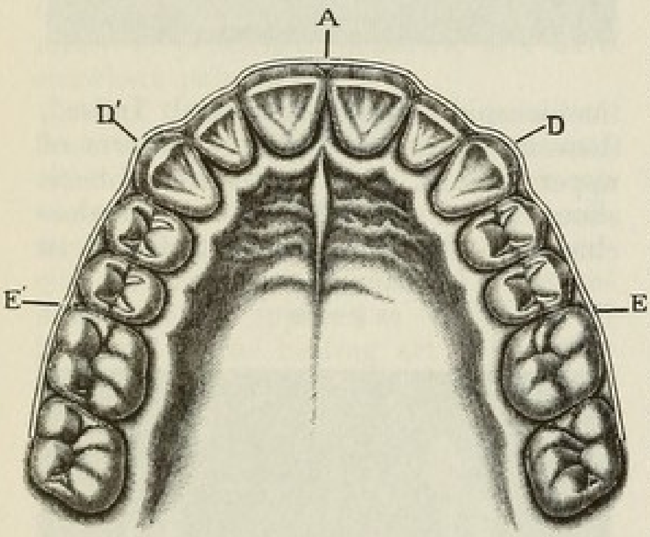


our so-called up-to-date textbooks, and even in some of the drawings of works on dental anatomy.

Teeth without artificial support could never possibly remain in such positions, for there could not be mechanical balance mesiodistally between the normal proximal contacts of the teeth, nor between the inclined occlusal planes of opposing teeth, nor balance of the muscles, nor of teeth and muscles with the mandibular bearings.

To make the point clear: Figure 8 shows the form of an upper dental arch and the relations of the teeth attained in treatment in what was supposed to be an ideal result. Now this dental arch is too wide in the bicuspid region, and all of the incisors, especially the laterals, have been moved too far labially. If the teeth had been moved into their *correct* positions during treatment, they would lie in close lingual relations to the superimposed metal arch in the illustration. Figure 9 shows another case subject to the same criticism.

Fig. 10



A careful examination of treated cases will show that most of them are left only partially completed even after long years of treatment, which alone accounts for many failures. For neglect to move teeth into their full and complete normal positions and relationships during treatment, there is not the least excuse.

Now how is the proper shape of the metal arch to be determined? There are in dentures five points or "landmarks," so to speak, from which the ideal—the typal—form of both dental and metal arches may be quite accurately determined, regardless of the irregularity of position in which the teeth may be found. This at least is possible to him who can interpret the mechanics of the denture and relate the types of the teeth to the type of the individual. These landmarks are indicated at A, D, D′, E and E′, in Fig. 10, which is a drawing representing the ideal arrangement of the teeth in a fairly average normal upper dental arch, with a metal arch lying in juxtaposition to the teeth at the points of their proximal contacts.

It will be noted that there is a straight line from the center of the labial ridges of the cuspids, D, D′, to the center of the mesiolabial ridges of the first molars, E, E′. This line is always straight, regardless of the degree or form of the curve of the anterior part of the dental arch or of the lateral width between either the cuspids or the molars of the halves of the arch; this width, of course, always varying according to the type of the individual, that is, as the widths of the incisors intervening between the cuspids and the typal curve of the individual arch vary.

Now, in shaping the metal arch to the ideal typal form of the dental arch in any given case, we must determine, first, the exact length and correct form of the curve which terminates at the labial crest of the prominent ridges of the cuspids (D, D′, Fig. 10). This is easily accomplished by laying a straight bar of metal of ample length (from which the metal arch is later to be formed) on a piece of paper and indicating its length by pencil dots (Fig. 11). The exact center between these points is now determined by means of calipers and indicated by a dot, as at A, Fig. 10, and A, Fig. 11. This dot represents the point of mesioproximal contact of the central incisors, and is our basic point for further measurement.

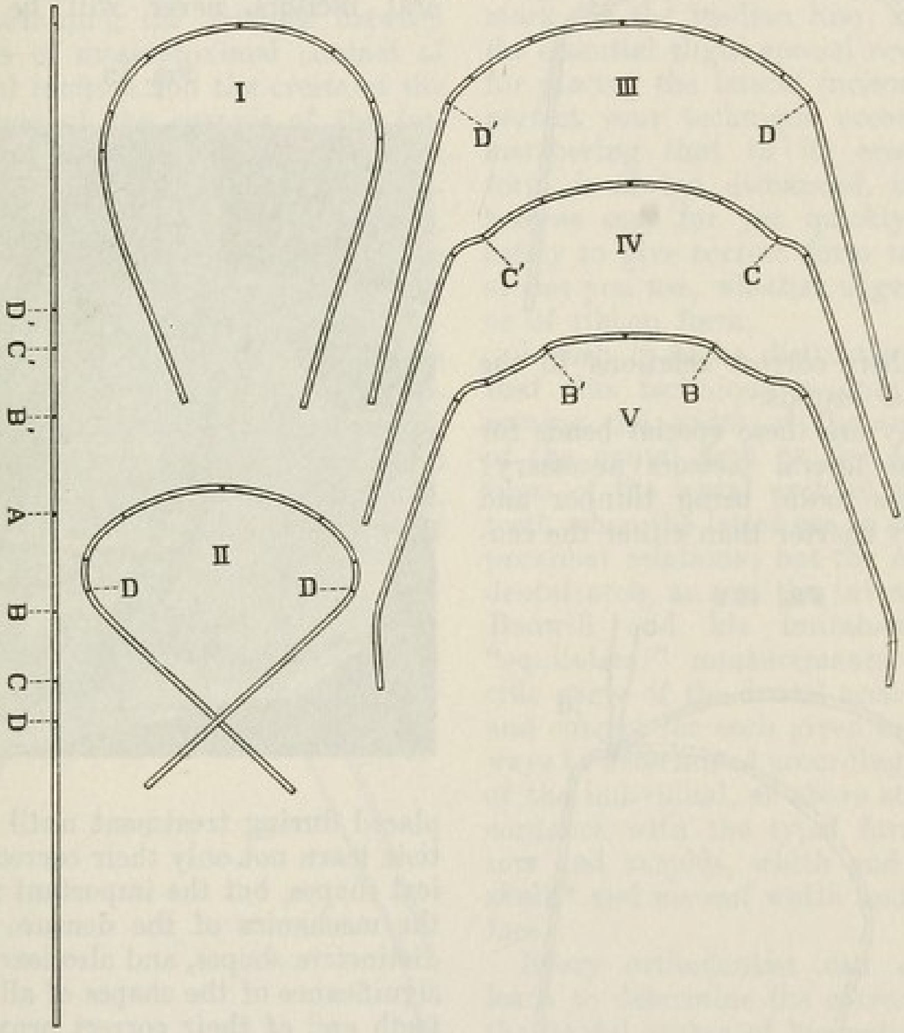
The widths of the crowns of the central incisors at their mesioproximal and distoproximal anatomical contact points are now carefully determined and indicated by dots (B and B′, Fig. 11). The widths of the adjoining lateral incisors are next determined, and indicated in like manner at C and C′; and also the widths of the cuspids from the points of their mesioproximal contacts to the center or crest of their labial ridges, as at D and D′, Figs. 10 and 11.

The metal bar is now laid in close relation to these dots, and the points, A, B, B′, C, C′, D and D′, are indicated thereon by slight notches in one edge of the metal, best made by means of a sharp knife used with a sawing motion. These marks should not be deep enough to injure or weaken the metal, but of sufficient depth to last throughout treatment, since they must frequently be referred to as the positions of the teeth change and the metal arch is reshaped accordingly, especially the three of greatest importance, or those that indicate the positions of the median line and the crests of the labial ridges of the cuspids.

The metal bar, if of the rectangular form, is now bent edgewise in the arch former (A, Fig. 4), step 1, when it will have the shape shown at I, Fig. 11. It is further shaped by additional short bends at the labial ridge of the cuspid in the smallest step of the arch former, as at D, D′, II and III, Fig. 11, step 2.

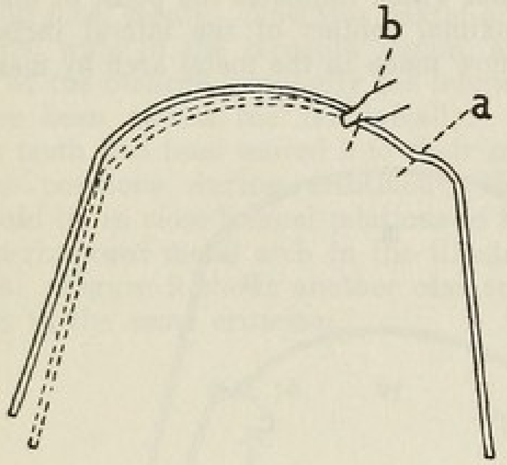
A slight curve in the opposite direction to the general curve of the arch, corresponding in position to that of the notch which indicates the point of distoproximal contact of the lateral incisor, is now made in the metal arch by means of the arch bender (B, Fig. 4), step 3, shown at C, C′, IV, Fig. 11, and at *a*, Fig. 12A. Finally, two further slight curves in opposite directions—one on each side of the mark which corresponds in position to the point of mesioproximal contact of the lateral incisor, also made by means of the arch bender, step 4, shown at B and B′, Fig. 11, and at *b*, Fig. 12A—complete the special curves for locating the lateral incisors. These bends and counter-bends are the most

Fig. 11



exacting of any to be made in the metal arch. The technique of their correct making should be carefully cultivated until the arch can always be given the precise form necessary to insure the final very important placing of the lateral in-

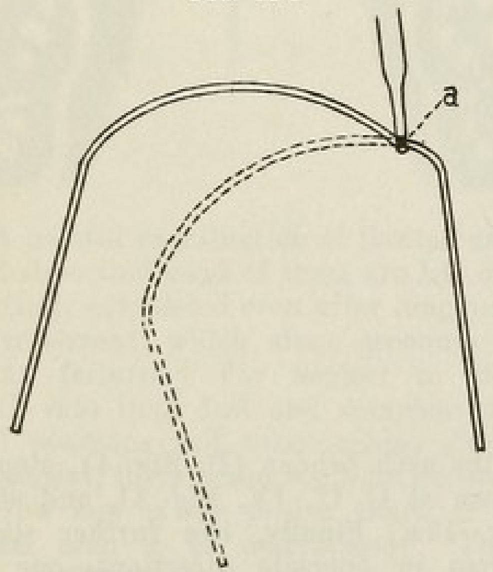
Fig. 12 a



cisors in their correct relations to the centrals and cuspids.

Now, why are these special bends for locating the lateral incisors necessary? Because this tooth, being thinner and considerably shorter than either the cen-

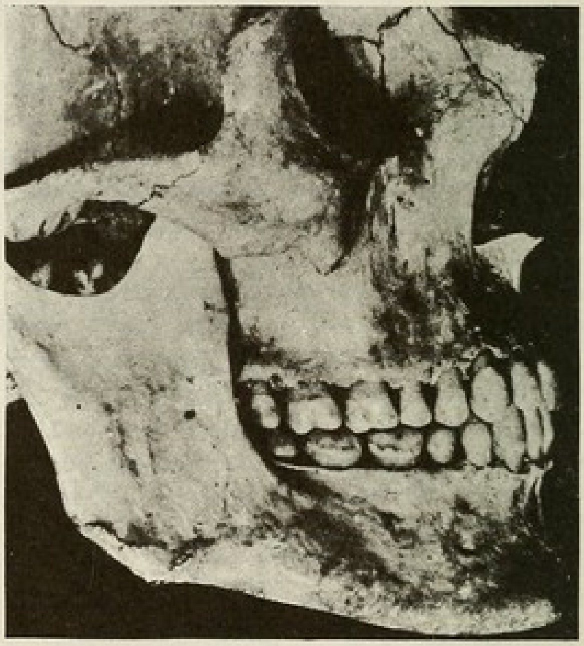
Fig. 12 b



tral or the cuspid, must necessarily be less prominent than they, both labially and occlusally, in order that it may function normally and efficiently, with the opposing teeth evenly arranged as to height and curve, and balance in its proximal contact relations; in other words, to avoid the frequent wrong placement of these teeth, illustrated in Figs. 8 and 9. Both dynamics and art demand its being placed in its own distinctive position, shown in Fig. 13, a position it occupies in all normal dentures that I have been able to find in an extensive examination of skulls. This I pointed out long ago.*

That the true position these teeth should occupy is so little regarded is as surprising as it is unfortunate, but lateral incisors never will be correctly

Fig. 13



placed during treatment until orthodontists learn not only their correct anatomical shapes, but the important reasons in the mechanics of the denture for these distinctive shapes, and also learn the true significance of the shapes of all the other teeth and of their correct proximal contact relations in the mechanics of the denture.

The peculiar expression of the mouths of many persons who have just been treated for malocclusion of the teeth is easily to be accounted for in many instances by the wrong placing of the lateral incisors, the effect, in the natural denture, being even more noticeable and

* "Malocclusion of the Teeth," seventh edition.

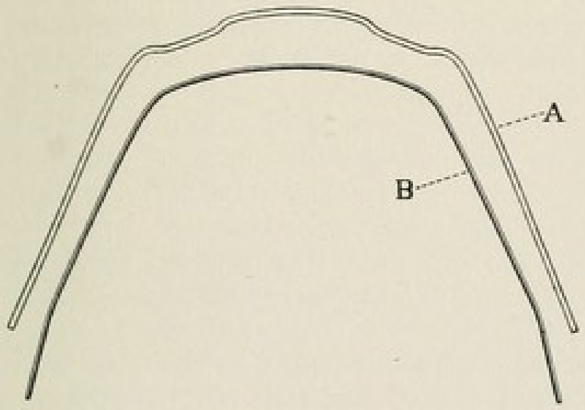
unpleasing than in artificial dentures, in which the most offensive disregard of their correct positions has for so long been the custom.

The special curves in the metal arch necessary to the correct placing of the lateral incisors may (preferably) be made in the beginning of active treatment, or they may not be made until toward its close, but whenever made they must be done with care and accuracy and never exaggerated as the pseudo-orthodontist usually persists in doing.

In determining the distance between the points of mesioproximal contact of the central incisors and the crests of the labial ridges of the cuspids of the lateral halves of given dental arches, it must be remembered that there are instances in which the two central incisors, and especially the two laterals, vary in width. Of course such variations will need to be duly considered.

Again, since bracket bands will be needed upon some or even all of the anterior teeth, it is best to do this banding before the measurements are made and the form of the metal arch determined, in order to allow for the thickness of the bands.

Fig. 14



The metal arch for the lower teeth, shown at B, Fig. 14, is formed according to the same technique as that for the upper teeth (shown at A, Fig. 14, and in Fig. 10), but without the special reverse curves for locating the lateral incisors, the four lower incisors and the anterior halves of the lower cuspids being evenly aligned both occlusally and mesiodistally, and curved in accordance with the widths of the teeth and the type of the individual patient.

If you will study the form of the upper metal arch, illustrated in Fig. 10 and at V, Fig. 11, and have clearly fixed in your minds the essential basic points in determining this form, namely, first, the width of the anterior part of the dental arch from the points indicating the crests of the cuspid labial ridges; second, the straight legs of the metal arch from these points to the mesiobuccal ridges of the first molars; third, the mark for the median line; and, fourth, the essential slight special reverse curves for placing the lateral incisors, and will perfect your technique accordingly, remembering that in its essentials this form is always demanded, it will soon become easy for you quickly and accurately to give correct form to the metal arches you use, whether edgewise, round or of ribbon form.

I wish it to be distinctly understood that this technique is only for determining the *width* of the anterior part of the dental arch or the correct relations of the metal arch to the anterior teeth when the latter are in their correct proximal relations; not the *curve* of the dental arch, as was the intention of Dr. Bonwill and his imitators in their "equilateral" measurements. The specific curve of the dental arch peculiar to and correct for each given case must always be determined according to the type of the individual, as above stated, in accordance with the typal forms of incisors and cuspids, width and contour of skull,* and *normal* width and contour of face.

Every orthodontist can and should learn to determine the correct curves of the dental arches of his patients, for he certainly has sufficient opportunity for the study of faces and types in those of all ages all about him, and there is not the least excuse for the plan which seems to be followed by many: that of having all of the upper arches of the cases they treat of a uniform curve, usually too wide or too narrow. To give an upper dental arch, narrow and of pro-

* "Malocclusion of the Teeth," seventh edition.

nounced curve, with prominent central incisors, to a patient with a broad round face and with incisors of a short broad pattern; or to give a flat broad arch to a patient with a long narrow face and the accompanying long narrow teeth, as is so frequently done, is to produce results so incongruous and inartistic as to be truly deforming in their effects.

It is said that orthodontists unconsciously copy the typal curves of their own dental arches in molding those of their patients. If this is true, it certainly reflects on their knowledge of art, anatomy and mechanics.

Of course it is to be understood that if the permanent cuspids have not erupted, the points on the deciduous cuspids which we have designated as basic points will be used instead; or, if both are absent, the basic points will have to be estimated, just as has long been done under similar circumstances in determining basic points in making diagnoses and classifying cases.

(To be continued.)

The Latest and Best in Orthodontic Mechanism

By Edward H. Angle, M.D., D.D.S., Sc.D., Pasadena, Calif.

(Continued from Vol. lxx, page 1158.)

TOOTH MOVEMENTS; GENERAL CONSIDERATIONS

With metal arches ideally formed, as directed, sprung into position and properly engaged in their attachments on the teeth, it is surprising what a large percentage of tooth movements may be accomplished with them in this form, for example, labial, buccal or lingual movements, rotation, elevation, depression, etc.

Of course, in cases in which the dental arches are greatly at variance to their correct forms and the teeth to their correct positions, the ideally formed metal arches would necessarily undergo slight temporary bending or modification of form if they were to be sprung into and ligated in *all* the attachments on their first adjustment. It will be understood, therefore, that under such conditions an arch must not be seated in all of the attachments on its first application, but gradually, yet as rapidly as is practicable, as tooth movement proceeds. (See Figs. 16 and 18.)

After originally shaping the metal arch to desired form and before its first adjustment, it is an excellent plan to trace its outline on paper (Boyd). This will assist subsequently in restoring the metal arch to its original form in accordance with the markings before reseating it in its attachments, the restorations, easily made with the fingers, naturally growing less and less as the work goes on. In many cases no restorations are necessary, and usually not more than two or three are required. In this way the general movement of the teeth is always correctly directed.

Thus far we have considered shaping the metal arches for restoring individual dental arches to correct typal forms and the teeth of these arches to normal heights and normal proximal relations, only. Fortunately, this is all the bending of the metal arches that is required in the treatment of a large percentage of cases, especially Class I cases of young children. But where, in order to restore dental arches to normal relations to the skull or to the temporomandibular articulation or to each other, and the teeth to normal occlusal relationships, individual root movement, or the tipping distally to normal upright positions—positions of correct axial relations—of single teeth or groups of teeth is required, movements of great importance, and by no means rarely necessary, additional bends in the metal arch of a different kind, small, specific and definitely located, are demanded.

It is of the utmost importance that these two distinctively different kinds of tooth movement and the two distinctively different kinds of bends for their accomplishment be clearly understood, and, in practice, kept distinctly separated. The two kinds of tooth movement we shall refer to as the first and second orders of tooth movement, respectively, considering now the first.

FIRST ORDER OF TOOTH MOVEMENTS

For a clear understanding of the purposes and the relations of the parts of the new mechanism for effecting the first order of tooth movements, we shall first show them in their simplest application on the deciduous teeth of a human mandible (Fig. 15), although in general the technique of adjusting and operating the mechanism for like tooth movements in upper and lower dental arches is practically identical.

Anchor clamp bands have been placed on the first molars and bracket bands on the incisors and cuspids, the metal arch resting in the sheaths of the clamp bands and in the horizontal slots of the open-face brackets (brackets No. 1, A, Fig. 2) of the bands on the anterior teeth. An open-face bracket offers such mechanical advantages for conserving the elasticity within the metal arch while the arch is being adjusted and for giving such complete control over the movement of individual teeth after adjustment that it should make a strong appeal.

Fig. 15

Ligatures are shown on the cuspids and the lateral incisors. It will be noted that they serve the double purpose of exerting force in the directions in which these teeth are to be rotated and otherwise moved and of keeping the arch firmly engaged in the slots of the brackets not only on these teeth but, indirectly, on those of the central incisors in which the arch is not otherwise locked, although minute staples are in readiness on the bands for the purpose, if needed, later.

The metal arch here used is of the delicate round arch material (D, Fig. 2), this being plainly indicated, since only the simple shaping of the dental arch to ideal form is required in this deciduous denture.

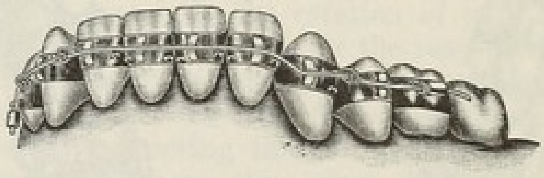
Before being sprung into its attachments on the teeth, the metal arch is given correct typal form, determined as before described, which, by reason of its elasticity and its firm attachments, would in a few days bring the teeth into harmonious arrangement in a dental arch thus re-formed, and without need of restoring or modifying the form of the metal arch or of readjusting it.

The delicacy of the mechanism, the firmness of its attachment and the directness of the force exerted by it on the teeth individually and collectively should be noted. At the same time there is nothing to prevent the habitual, thorough use of the toothbrush by the patient, hence the tissues may be kept in a clean wholesome state.

The novel manner in which the ligatures are locked will appear later.

Figure 16 shows the mechanism in position on the teeth of the mandible in an older case, that of a mixed denture, with an ideally formed edgewise arch seated in the brackets and sheaths, and with minute staples at each mesiolabial and distolabial angle of each anterior

Fig. 16



tooth band in readiness for the later engagement of ligatures, should they be needed, so that force in the amounts and directions desired may be completely controlled. As the slight rotation of the right lateral, the cuspids and first bicuspids is indicated, ligatures are seen to be engaging the metal arch and minute staples at the extreme distolabial and distobuccal angles of the bands on these teeth for exerting force for the purpose.

It should also be noted that staples are attached to the metal arch, anterior to the sheaths of the anchor clamp bands, to prevent the arch from sliding distally within them, and that on one side two of the little washers (G, Fig. 2) rest between staple and sheath; this to further illustrate one way of extending the metal arch instead of using the screw method (see also Fig. 3); or the staples themselves may be teased distally on the arch to effect the same result.

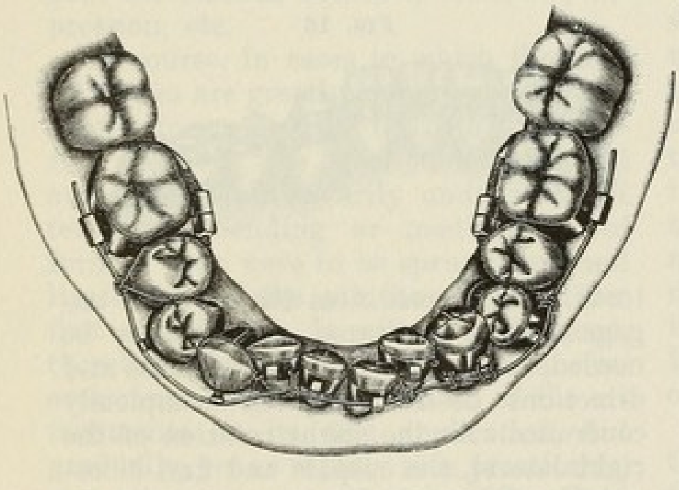
It will be noted that the malposition

of all of the teeth as to height is also being corrected.

Figures 17 and 18 show a still older denture in which malocclusion has developed to a more complex condition, that is, the dental arch is shortened, with lingual displacement, bunching and elevation of the incisors and cuspids, with some rotation, and with slight mesial tipping of bicuspids and molars, clearly the result of the very frequently indulged in habit of forcibly drawing the lower lip inwardly against the labial surfaces of

FIG. 17

FIG. 18

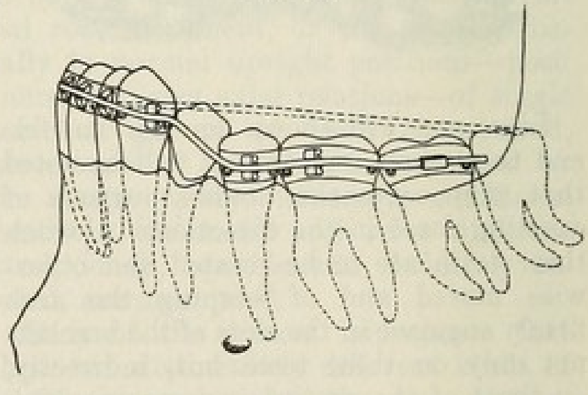


the anterior teeth. A similar condition is also produced by the more rare habit of continued pressing with a forefinger in the region of the mental depression.

B, Fig. 14, shows the metal arch as typally formed before it is sprung into position on the teeth in this case, the delicate round arch which would here exert all the force required. In Figs. 17 and 18 it is shown in position on the teeth and it will be noted that in this, its first application, it has not yet been seated in the slots of the entire series of brackets. Because of the extent of malarrangement of the teeth, to do this at this time would require its too excessive bending and change of its original ideal typal form, and it is not necessary, since force is fully and freely applied and controlled, and reciprocally and automatically distributed, principally through the ligature and staple attachments, for the simultaneous individual and collective movements required; that is, the labial movement and rotation of the lateral incisors, the right central and the left cuspid, rotation of the left first bicuspid and depression of the anterior teeth. The control of force through this gradual engagement of the metal arch in the complete series of brackets, as the teeth assume sufficiently normal positions in the dental arch to make it possible without seriously impairing the ideal form of the metal arch, is one of the great advantages to be gained in the use of this mechanism.

The renewal of the ligatures would probably be all the attention needed at

FIG. 19



the second visit of the patient, and at the third visit the teeth should show such favorable changes of position that the metal arch, after slight modification to restore it to its original typal form, could readily be seated in *all* of the brackets, as in Fig. 19. Thus the movements of the teeth would be physiologically progressive in the right directions only and so continue to a speedy termination of treatment.

It will be noted that two ligatures engage the left cuspid, one through the medium of the staple at its anterior labial angle, for rotation; the other by means of the upper wing of the bracket, which will depress this tooth and move it labially, as well as assisting reciprocally in elevating and rotating the left first bicuspid. Temporary advantage may often be thus taken of the wings of the brackets in the early stages of placing the arch, as in the case last described. It will also be noted that a simple ligature engages the right second bicuspid to effect its buccal movement and to react reciprocally for the lingual movement of the right first bicuspid. Nothing else could be more simple and effective for the purpose.

Staples at each labial angle of the incisor bands are also shown in this illustration, as in the last two (Figs. 15 and 16), and for the same purpose.

We have seen that required labial and lingual movements of the crowns of teeth, also the elevation and depression of teeth, illustrated in Figs. 16, 17 and 18, are accomplished automatically and simultaneously as a result of their firm, direct attachment through brackets and ligatures or staples and ligatures, as above described, to ideally formed elastic metal arches. We have also seen that the slots of the brackets open outwardly and in a horizontal direction, which makes it easy to spring into them metal arches ideally formed for cases in hand. Then, by means of the delicate ligatures which accurately lock the arch into these slots, the elasticity of the metal of the arch becomes fully, freely and directly active. It will thus, as I have said, operate continuously, without necessity for frequent changes in its form, over a longer period than is required with arches secured in vertically opening attachments in which frequent changes of form, in order to re-exert power, are necessary, such changes often making uncertain the directions in which the force is acting. In reality, the exact directions in which force is exerted on each and every tooth, both those being moved and those used as anchorage, should at all times be perfectly clear in the mind of the orthodontist and readily traceable in the functioning of the mechanism.

The great importance of fully correcting the positions of all teeth that require rotation should be obvious to every real student of the dynamics of the denture, for only by the complete correction of this malposition of teeth can the normal length of the lateral halves of the dental arches be established and harmony and maximum efficiency of the teeth in their inclined occlusal plane relationships be secured. Moreover, the interlocking of the inclined occlusal planes, upon which the ultimate retention of the teeth depends, will fail of fulfilling this function unless each tooth in a rotated malposition be moved into its fully normal mesiodistal position, with accurate relations at its points of contact—points of balance—with the adjoining teeth. When indicated, this movement should always be undertaken promptly; not winked at or left to the last to greatly and unnecessarily prolong the period of active treatment. In reality it should be one of the very first movements to be begun in all cases, especially the rotation of cuspids, bicuspids and molars, for the reason that it is one of the most difficult movements and requires the most force and the most care in directing the force, and usually consumes more time than other movements.

Means for accomplishing this movement is preëminently the weakest point in nearly all orthodontic mechanisms,

Fig. 20

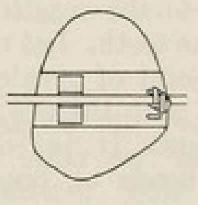
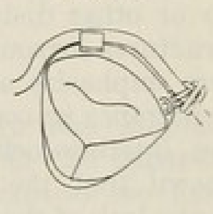


Fig. 21



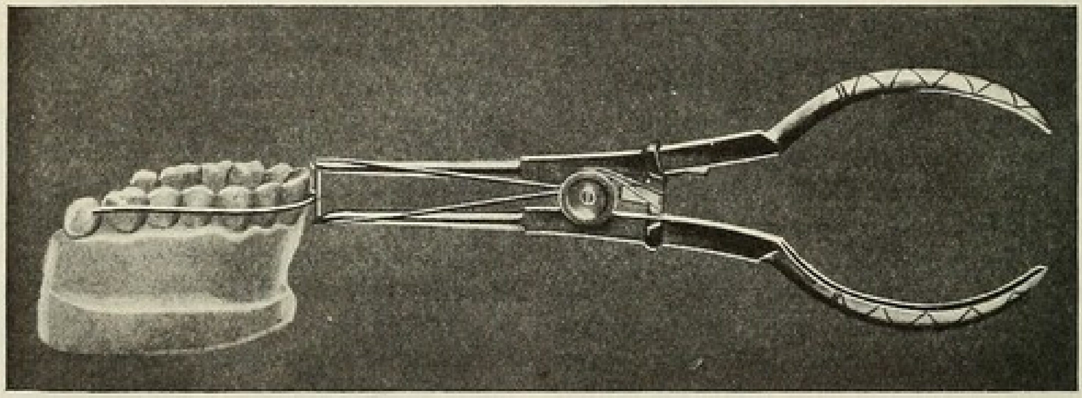
but in the use of that under consideration the principle of the spring lever doubled is employed, and by reason of the firmness of its attachment the lever functions in the most efficient and direct manner, so that rotatory force is evenly and probably more continuously and effectively operative than in the use of any mechanism heretofore available, again illustrating the adaptability of this mechanism to normal cell stimulation and the laws of physiology.

Figures 20 and 21 illustrate the rotation of a cuspid through its attachment by means of band, bracket, staple and ligature to the elastic metal arch. The distance between bracket and staple (which represent load and fulcrum) should be as great in each attachment as is practical, for reasons that will be obvious.

In effecting rotation the larger size ligature wire (.015″ in diameter) should usually be employed, the ligature being tightened and the first locking twist always made in it by means of the ligature-locking pliers shown in Fig. 22. By no other means can the force exerted by the ligature be so powerfully and so nearly equally distributed with so little jar or other disturbance to the sensitive structures surrounding the tooth. Let me here emphasize another point of greatest importance in connection with the use of the ligature-locking pliers. It is well known that the initial bends or hooks in the lock of the ligature must bear most of the strain in locking and final stress of the completed ligature. Now, if these hooks can be drawn close and very evenly, as is easily possible in the use of the ligature-locking pliers, far greater strength and efficiency of the ligature is gained than if larger and less accurate bends are made in the hook-locking relations, such bends being unavoidable when the hands alone are employed in effecting the locking. This fact can be easily verified by the use of the microscope and stress tests.

Force is renewed by applying a new ligature. And in this connection I would call attention to an additional very simple and practical way of lengthening the periods of activity of the mechanism, namely, by applying a new ligature before removing the old one, easily done by having provided a second staple for the purpose before setting the band, as in Figs. 20, 21 and 27. This is a point of such practical value that it should be taken advantage of whenever possible, for the obvious and very important reason that it prevents shock, soreness and pain from the "back lash" when the tooth is released through cutting the first ligature and consequent interference with the osteoclasts and osteoblasts in their work of tearing down and rebuilding the alveolar structures.

Fig. 22

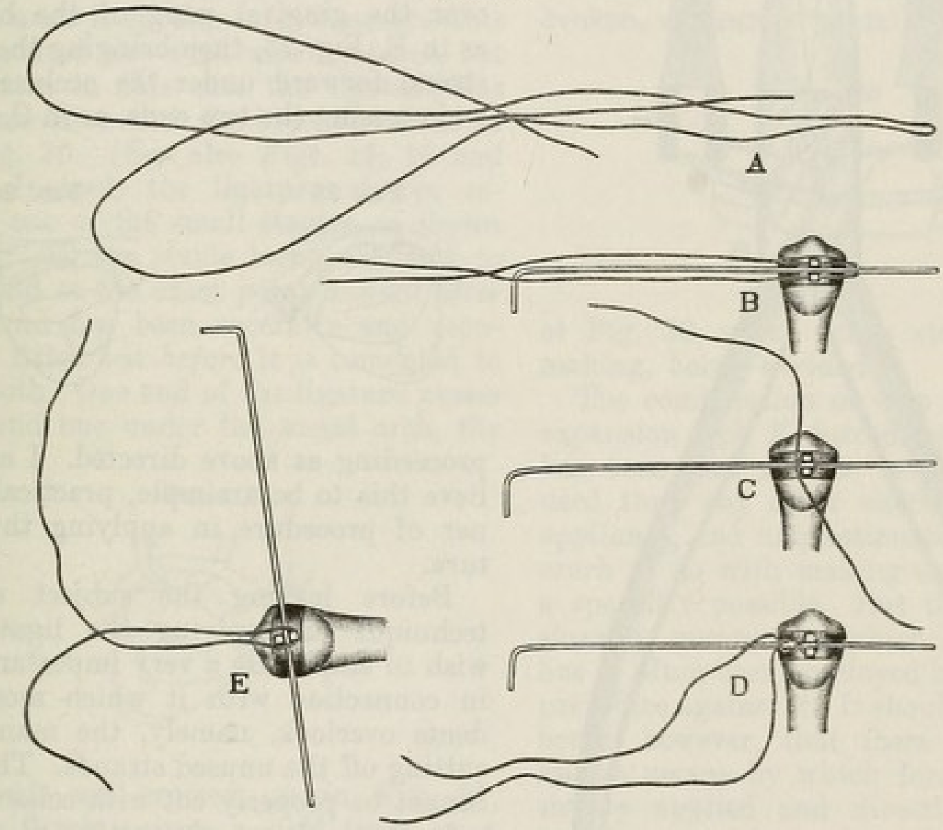


Another advantage of this extra staple is, that after the active period of rotation is ended and but one ligature is required, this single ligature may be engaged with both staples before bringing its strands forward and crossing and locking them, thus giving the most even support in the temporary retention of the tooth. Of course steady, balanced temporary support of a tooth is also afforded in like manner where a staple is used on each of the labial angles of the band, as in Figs. 15, 16 and 17.

This method is especially pleasing in its results in temporarily retaining a single tooth in contact with the metal arch while the movement of other teeth is being completed, because it holds the corrected tooth so steadily.

So practical and unobtrusive are the delicate staples that the orthodontist should anticipate their possible need for any later-to-be-required tooth movement, freely attaching them to bands in the initial application of the mechanism to the teeth and thus adding to his resources for the more perfect control of force.

FIG. 23

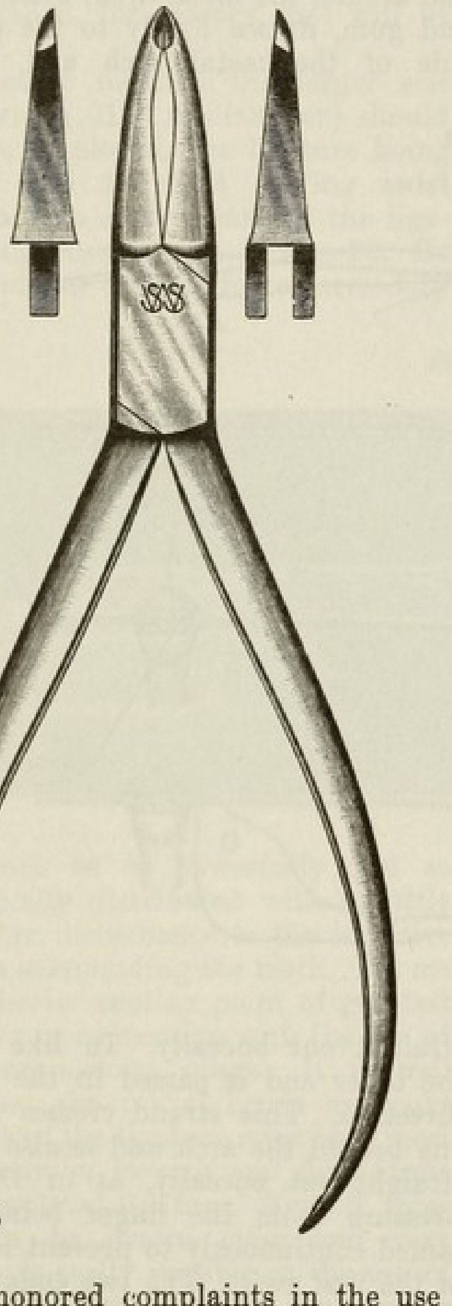


the bracket, its ends then being crossed, as at C. The two ends of the ligature are now drawn tight and united either in a half twist or a whole twist according to the degree of force necessary to keep the arch seated within the bracket, D. One finger is now pressed on this twist while one end of the ligature is passed under and around the metal arch, between arch and gum, drawn firmly to the opposite side of the metal arch and brought straight out buccally. In like manner the other end is passed in the opposite direction. This strand crosses the first one behind the arch and is also brought straight out buccally, as in D, steady pressure from the finger being maintained continuously to prevent loosening of the first twist. The two ends are now drawn tight, as in D, and are ready to be cut off with the pin cutters, Fig. 24, just short of the outer edge of the metal arch, as shown in Figs. 23, 25 and 26. Thus the ends of the ligature have been crossed in front of the metal arch and locked by a twist, then crossed behind

TECHNIQUE OF APPLYING LIGATURES

The wire ligature as a means of applying and controlling force, as well as of holding the arch within the brackets, is of such importance in the use of this mechanism that the correct technique of its application should be followed most carefully by all who employ it. This technique is as follows: In the middle of a strand of the ligature wire there is made a tiny loop, as at A, Fig. 23. The sides of the loop are caught under the wings of the bracket, as at B. The ligature is drawn until the loop lies firmly against the arch, firmly drawn forward, clinched and cut off. In this way a very firm locking of the ligature is secured and its ends are so effectively disposed of that they cannot be interfered with by the cheeks or fingers of the patient, one of

FIG. 24



the time-honored complaints in the use of wire ligatures thus being eliminated.

As there are thus practically two ligatures operating to hold the arch within the slot of the bracket, the wire of the ligature may be very delicate—but .010″ in diameter—and therefore easily manipulated.

A difficulty the operator may experience in his early attempts to adjust the ligature according to this method is to prevent the unlocking of the first twist while the ends of the ligature are further manipulated. This technique, however, is very readily learned, slight pressure from the little finger of the left hand being ample to prevent the unlocking, the other hand being free to pass the ends of the wire, as above directed.

Dr. Roscoe A. Day suggests the application of the ligature by first looping it over the gingival wing of the bracket, as in E, Fig. 23, then bringing the distal strand forward under the occlusal wing and crossing the two ends, as in C, finally

FIG. 25

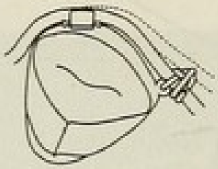
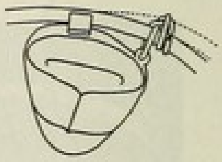


FIG. 26



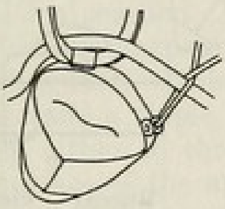
proceeding as above directed. I also believe this to be a simple, practical manner of procedure in applying the ligature.

Before leaving the subject of the technique of applying the ligature, I wish to emphasize a very important item in connection with it which most students overlook, namely, the manner of cutting off the unused strands. The wire cannot be properly cut with scissors, but only clean, sharp, pin-cutting pliers can be successfully used for this operation. In cutting off the occlusally placed strand the two blades of the cutters are placed parallel to the edge of the long axis of the arch bar at its labio-occlusal angle or corner, as if an effort were to be made to trim off a portion of this corner of the arch. But instead, in closing the blades, the upper strand of the ligature wire is cut off, in this way making a beveled cut slightly below the outer edge of the arch. In like manner the gingivally placed strand is also clipped off, thus leaving the two ends of the locked ligature shorter than the occlusal and gingival surfaces of the arch against which, respectively, these ends rest. Their interference with the cheek or lip of the patient and their being interfered with by the toothbrush is thus prevented. Of course only one strand is cut off at a time.

I sincerely hope this method will be studied and followed literally, as it is a real step forward in ligature technique.

The second or beveled-end type of bracket (bracket No. 2, shown at A and C, Fig. 2) is especially adapted for use on anterior teeth, as has been said. The metal arch is sprung into these brackets and secured also with wire ligatures, but of course in this case the ligature has no connection with the bracket, as shown in Fig. 20. (See also Figs. 15, 16 and 17.) Instead, the ligature always engages one of the small staples, as shown in Fig. 25, the staple being attached to the band at the exact point desired *after* the band has been carefully and accurately fitted but *before* it is cemented to the tooth. One end of the ligature passes over and one under the metal arch, the

FIG. 27

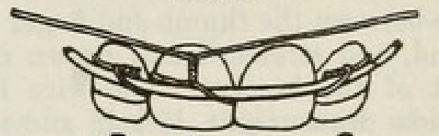


two ends are crossed, as in Fig. 27, drawn firmly, given a half twist or a whole twist, and disposed of as already described and as illustrated at D, Fig. 23, and in Figs. 25 and 26. This ligature being single in its effect, it is usually better to employ strands .015″ in diameter, but never heavier; but where little or no force is required to maintain the arch within the slot the wire .010″ in diameter will answer.

This novel form of bracket and ligature attachment is so very compact, simple and efficient as to appear to closely approximate the ideal.

If you will carefully analyze the mechanics of these two types of brackets, noting the rigid relation of the arch within them and the firmness with which the arch is held, it will be clear that force control may thus be effected and maintained in the most stable and dependable manner for the movement of teeth in any direction. I cannot too strongly emphasize, however, the importance of following closely, until they are mastered, the simple steps in the technique of applying and cutting off the ligature, as here given, so that the operation can be quickly and effectively performed, the loose, unsightly, easily broken, uncleanly "pigtail" twists, shown

FIG. 28



at Fig. 28, which many still persist in making, being avoided.

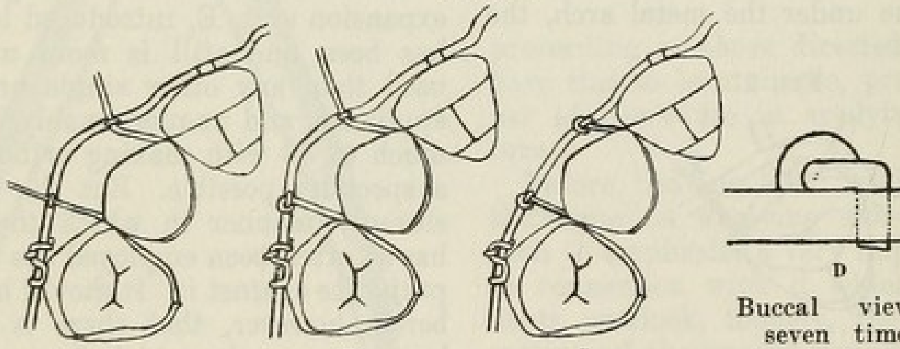
The combination of wire ligature and expansion arch E, introduced long ago,* has been and still is more universally used than any other single orthodontic appliance, and unquestionably it has had much to do with making orthodontia as a specialty possible. But the loose and slovenly manner in which the ligature has so often been employed has awakened prejudice against it. It should be remembered, however, that there is no other known means by which force can be so simply applied and directly controlled for the movement of teeth. Doubtless many who are now prejudiced against it will make haste to condemn the new mechanism because of the inclusion in it of wire ligatures, but if they will first take the trouble to master the proper use of the new mechanism and of the novel manner of employing the ligature, described herein, they will realize that the ligature is a factor in force control of such indispensability that no real orthodontist can afford to ignore it.

In its use in connection with the new mechanism the period of activity of a

* "Malocclusion of the Teeth and Fractures of the Maxillæ," sixth edition.

single ligature may be much prolonged in a simple and effectual manner, that is, by placing a very delicate block of rubber between the floor of the slot of the bracket and the arch. This is especially applicable in the movement of rotation, and is illustrated at Figs. 25 and 27. It is best accomplished in the following manner: The wire ligature is passed through the staple, its ends drawn up and loosely crossed, as in Fig. 27, but not drawn tightly. One end of a delicate strand of rubber (a half segment of the *smallest* of what are known as "election" rubber bands) is now passed under the arch and both ends of the rubber held, one between the thumb and finger of each hand, and stretched and drawn into the slot of the bracket. The wire ligature is now drawn tight, locked, and its ends disposed of in the usual way. Thus the rubber is firmly compressed between the floor of the slot of the bracket and the

FIG. 30



A B C D

Staples on occlusal aspect of arch. (×2½.) Buccal view of seven times actual size.

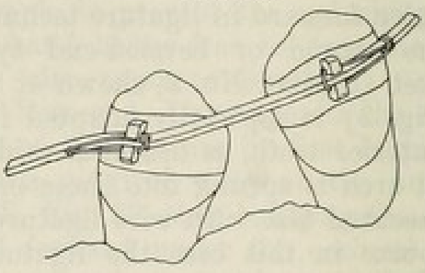
arch, as in Fig. 25. Both ends of the rubber are now grasped by the fingers of one hand, stretched evenly and clipped off together at the same instant with ligature cutters. The result is shown in Fig. 25.

This virile auxiliary force, gained by means so unobtrusive, will surely be appreciated by all who learn to employ it properly.

TECHNIQUE OF ADJUSTING SPURS AND STAPLES

It should hardly be necessary to say that in the use of this mechanism the control of force in exactly the directions required often demands the attachment of a spur or staple to the metal arch, just as we have long done in the use of older mechanisms, to direct the pull of ligatures and prevent their slipping along the arch,* for example, when it is neces-

FIG. 29



sary, as it often is, to direct force for the mesial or distal movement of a tooth or teeth at the same time that rotation or other movement is being effected.

Figure 29 illustrates the gaining of space between two leaning teeth by means of ligatures, the direction of force from the pull of the ligature being controlled by spurs or staples. I now prefer a staple for this purpose rather than a spur, it being easier to apply the staple originally and later to change its position, if necessary, by means of the soldering needle. Besides, the ligature, held by a staple, is less liable to accidental displacement than if held by a spur, and the rounded surface of the staple is more agreeable to the lips than is the surface of a spur. Both attachments are shown in the illustration.

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* "Malocclusion of the Teeth," seventh edition.

The staple may, of course, be attached at any required point on the metal arch, either for simply engaging the ligature, or to prevent its slipping, or to prevent the slipping of the metal arch distally through the anchor sheaths, as in A and B, Fig. 3, and in Fig. 35, and before described.

A point I would emphasize in thus employing the staple is that when so used it is not intended that the ligature should pass through the eye of the staple, at least not in all cases, but that usually the staple should serve simply as a spur, the reason being that it is always difficult to draw the ligature on a sharp curve through the eye of the staple. Yet there are many instances in which the skilful operator can so place the staple and manipulate the ligature through it as to be of real advantage, and it will doubtless become popular with many in other ways.

An excellent illustration of the possibilities of the staple and ligatures thus used in a new and unique manner, but not in rotation, is shown in A, Fig. 30, where a cuspid is to be moved from extreme lingual malposition. In adjusting the ligature for this purpose, each end is passed from lingual to labial through a proximal space and a staple, both staples being attached either to the gingival or the occlusal surface of the arch, A. (For ease of illustration they are here shown on the gingival edge.) One end of the ligature is then bent sharply around one of the legs of a staple, passed linguogingivally, drawn tight and clipped off close to the gingival surface of the arch, leaving an accurately fitting hook engagement, as in B and D, Fig. 30. Tooth and arch are now pressed between thumb and finger and the other end of the ligature firmly drawn through the other staple, as in C, and locked and trimmed in the same way, the ligature thus engaging the lingual surface of the cuspid.

In this manner power is increased as in the use of a single pulley, the tooth acting as the wheel, the second end of the ligature being drawn twice the distance of the first through the second staple, and the power distributed over two attachments instead of one, as in the use of the ligature in the ordinary way.

The simple hook manner of locking the ligature is ample to maintain the force from the arch.

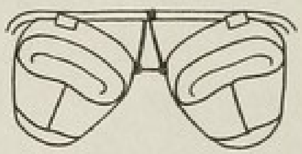
This double hook and staple attachment is one of the most stable, compact and cleanly of all attachments, but it does not prove so practical in cases where a tooth is to be moved only a short distance, as in rotation. Still, in favorable

FIG. 31

cases, as in Fig. 31, this manner of locking the single strand ligature within the staple may be used with real satisfaction in skilful hands, it being so very compact an attachment.

Figure 32 shows the use of staples in a simple and effectual method of accomplishing double rotation of central

FIG. 32

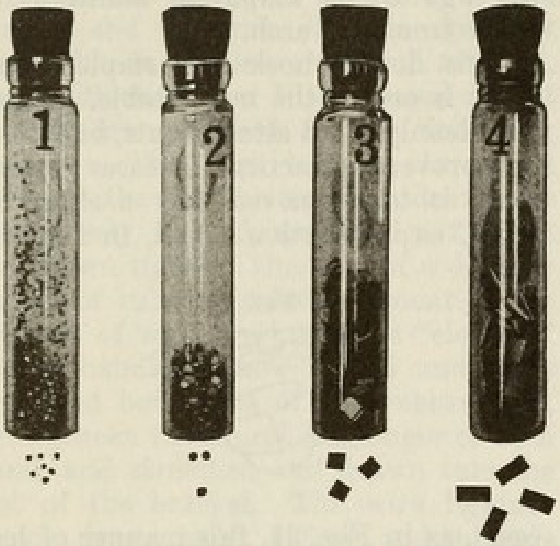


incisors and at the same time closing space between them, all with a single ligature.

It seems unnecessary to describe and illustrate a large number of the many ways of applying this mechanism for effecting rotation, either as a single movement or in combination with other required movements. These should be obvious, or will become so as familiarity with the mechanism increases.

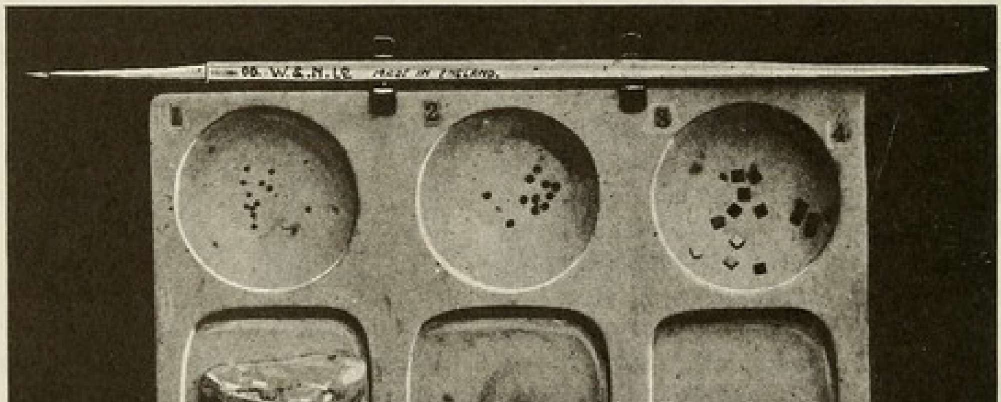
I would especially emphasize the importance of mastering the technique of locating, attaching and changing the positions of staples, either on bands or arches or wherever needed, as follows: At the desired point of attachment of the staple on band or arch, this point being carefully located and plainly marked, a No. 2 solder disk (Figs. 33 and 34) is partially fused. The staple

Fig. 33



is then picked up on the point of the tungsten soldering needle, which is then applied and evenly distributed and raised only to the fusing point of the solder. This technique should be repeated over and over until the staples can be attached at or teased to the exact point desired on any band or arch. This is only possible by first accurately determining and marking this point on the uncemented band in position on the tooth, or on the arch in the mouth. And I would strongly impress the importance of placing the staple on the band just as far mesially or distally (as the case may require) as the position of the adjoining tooth will permit. This for two reasons: first, to insure the firmest hold upon the band without loosening it; second, to secure the greatest leverage. Also it must not be placed so near either edge of the band as to weaken its attachment or in such position as to lie between band and metal arch when the arch is adjusted. In the latter

Fig. 34



firmly pressed against a piece of soft wood in order to fix the staple more securely upon it, carried to the point of attachment and steadily held in the flame of the Grünberg blowpipe while the heat, directed upon the needle first, is slowly

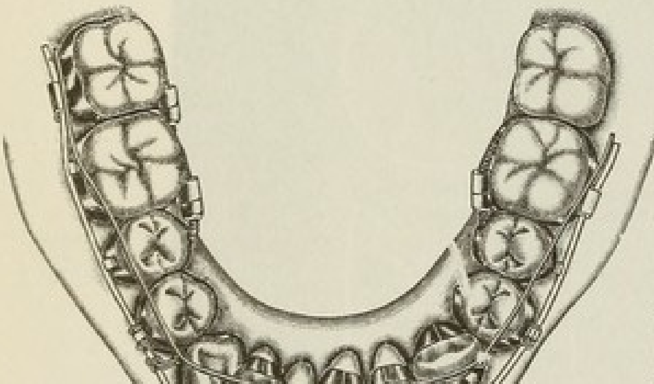
case the movement of the teeth would soon be restricted, necessitating the removal of the band and change of position of the staple, which could have been avoided by a little forethought.

SECOND ORDER OF TOOTH MOVEMENTS

We shall now consider the second order of tooth movements or the simultaneous tipping backward of all of the teeth on one or both sides of either or both dental arches, force for this purpose also being derived from the elasticity of the delicate metal arch already in position in the

FIG. 35

A



B

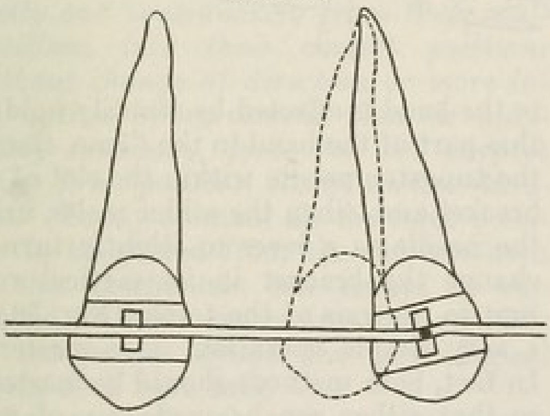
brackets and other attachments and operating at the same time for accomplishing the first order of movements. Figure 35 illustrates the use of the mechanism in a case which requires such movements; a complicated case, but yet a very common type of malocclusion, and one not caused by "heredity," "evolutionary changes," "faulty endocrins," "faulty metabolism," "unbalanced diet," or even an "inferiority complex," but just by the common habit of frequently abnormally contracting the lips, with the usual results: incisors bunched and overlapping, with more or less rotation; cuspids rotated; dental arches narrowed, their continuity becoming more and more broken as the eruption of the teeth progressed. Also, an almost constant accompaniment of these conditions, frequently overlooked, is a leaning or tipping forward of the cuspids and of all of the buccal teeth, an inevitable result of the great weight or stress of occlusion falling on teeth bereft of their natural resistance to—their natural balancing of—this stress. Normally, the muscular force from the lips, especially potent in each act of swallowing, prevents the drifting forward of the teeth and holds them in their normal upright axial positions. This force is transmitted to the individual teeth through their points of balance, or proximal contact points, from the incisors even to the third molars. But when a dental arch is broken through malrelations of the points of balance, the lips cannot exert normal influence and thus restrain mesial axial perversions of the teeth, and there must follow their tipping mesially, as well as an intensifying of the malrelations of their points of balance, as seen in Figs. 1, 65 and 67.* It seems reasonable to believe that this abnormal axial leaning naturally follows more or less in all cases in which the arches are thus broken, especially in cases

* The difference in the degree of mesial tipping of the teeth in the cases shown in Figs. 17 and 35 is easy to account for by the difference in the form of lip habit of the two patients, the respective habits being the cause of the malocclusion in both instances.

belonging to Class I, and in making diagnoses, its extent should always be carefully determined.*

To correct this condition modern science demands the uprighting of the leaning teeth into their normal axial positions and relations in order that they may be in harmony with the mechanics of occlusion and with the architecture of the skull. This is accomplished through tooth movements of the second order in which an even, gentle, continuous tipping force in a distal direction is exerted on their crowns, with no mesial displacement of their roots; this, of course, in addition to the correct shaping of the dental arches and the placing of the crowns of the individual teeth in their correct relations in the first order of movements already described. In this particular case (Fig. 35), in addition to the required movements of the first order, all of the teeth, especially those of the right half of the mandibular arch, need tipping into their correct position of uprightness, to the extent indicated by the superimposed, ideally formed metal arch. This is effected by adjusting the metal

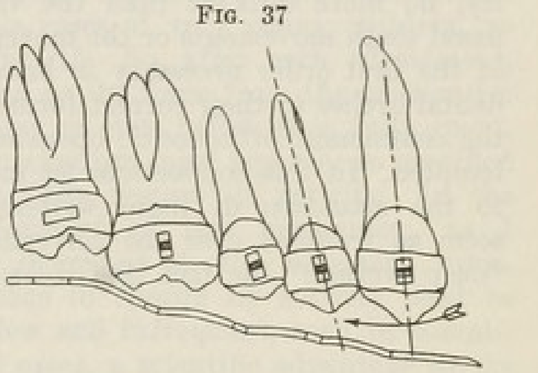
FIG. 36



arch (the second arch shown in working position on the teeth) in such manner as to cause it, when seated, to bind in the brackets and sheaths and to exert power favorable to this end. Figure 36, which is an enlarged diagrammatic illustration of the mechanical principles employed, and also Fig. 37, will serve to make the point clear.

It is obvious that if the arch lay passively within the brackets and sheaths no force would be exerted or tooth movement effected. But it will be equally clear that if, before seating it in its attachments, it were to be given two very slight, equal, vertical bends in opposite

FIG. 37



directions for each tooth, that is, one gingivally anterior to each bracket and sheath and one occlusally posterior to each bracket (Fig. 37), the result would be that when seated those portions that lie within the slots of the brackets and in the sheaths would be slightly oblique to the long axis of the metal arch. Therefore in placing it in position on the teeth it would require to be *sprung* into its attachments, when it would bind within the walls of all of them, prying gingivally on the distal end of the gingival wall and occlusally on the mesial end of the occlusal wall of each bracket and sheath.

The force from the elastic metal arch so enlisted and exerted must operate reciprocally from tooth to tooth and result in tipping distally their combined crowns. In other words, force thus enlisted would be expended upon the *crowns* of the buccal teeth and would cause their movement along the line of least resistance, or in a distal direction, while the movement of their *roots* in the opposite direction, or mesially, would be effectively resisted through their attachments to the alveolar process and peridental membrane, which would act as reciprocal, static force or anchorage of the firmest, most effective kind.

The operation of uprighting teeth

* Of course when the denture is undergoing changes from the deciduous to the permanent teeth the normal proximal contacts are for short periods absent, the spaces, however, being maintained, under normal conditions, through development forces.

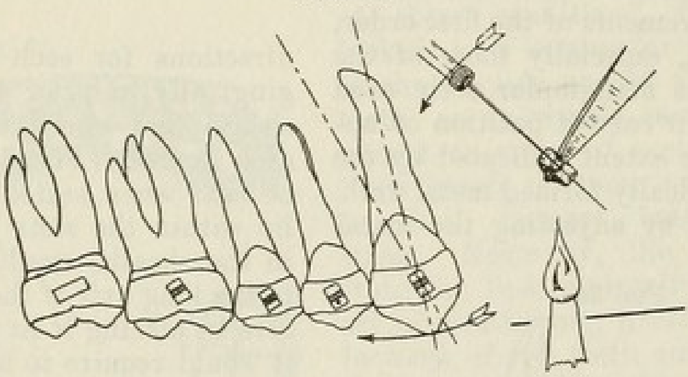
en phalanx has heretofore been regarded difficult, even its possibility being denied by Case, Cryer and many others; and it would be impossible today, if we had no more effective appliance for the purpose than is found in much of the mechanism at present employed for orthodontic treatment. But I hope to prove to you that in the correct use of the mechanism I am discussing, it is, in reality, no more difficult than the various usual tooth movements or the movements of the first order necessary to bring the dental arches to their correct forms, now the commonest orthodontic operation attempted. In this connection, let me call to the attention of those writers who seem so troubled over the correction of "deep overbite" the fact that if, in these cases, they would tip the buccal teeth backward and upward into correct axial relations and correct the form of the curve of Spee, the latter illustrated in Figs. 17 and 19, this "bogey" would vanish.

For both physiological and mechanical reasons it is always advisable that the operation of uprighting teeth should be carried on at the same time that movements of the first order are being effected, thus husbanding to the highest degree all the obtainable anchorage and reducing the period of active treatment by at least half from that which would be required if the two orders of movement were carried on independently, that is, if the second followed the first instead of being coincident with it, or if the indefensible "one tooth at a time" method were employed. Thus, also, false movements are eliminated and unnecessary disturbance of cell function and consequent injury, more or less permanent, to alveolar process and peridental membrane.

Another excellent way of causing the arch to bind within the brackets and anchor sheaths and thus to enlist force for the uprighting or distal tipping of the crowns of teeth is to change the positions of the brackets on the bands, thus changing the angles of relation of the slots of the brackets to the long axes of the teeth, shown in Fig. 38, instead of making the vertical bends in the arch, as in the manner just described. This permits the use of the arch in its simplest form, or that freest from bends, which of course has advantages. The change in the angle of attachment of the bracket to the band is effected by steadily holding this part of the band in the flame, resting the tungsten needle within the slot of the bracket and, when the solder melts, using the needle as a lever to slightly turn or change the bracket in its vertical relation to the axis of the tooth (Fig. 38)—a very simple operation, once mastered. In fact, both methods should be mastered so that either can be made use of with skill and confidence, or even in combination, if demanded. If the second method is used, the change in the position of the bracket must be made after the band has been fitted to the tooth, but before it is cemented in position, when the exact degree of change required can best be determined.

In advocating the first and second orders of tooth movement simultaneously I would not be understood as meaning that force should be enlisted for both at

FIG. 38



the very beginning of treatment. The patient should first become accustomed to wearing the mechanism, force being exerted gradually through the gradual engagement of the attachments for the first order of movements only, and with the metal arch lying passive, or nearly so, in its bracket and sheath relations, so far as the second order of movements is concerned. The first, however, should not have progressed far nor should much time have elapsed, say at most one month, before the metal arch is made active through the accurate, distinctive bends, or the realigning of the brackets, for the second order. Both should thereafter not lag, but go forward as rapidly as possible with all the power enlisted that is to be gained from this delicate arch. No harm can arise from employing all the force that can be enlisted from the arch, *provided the force be kept active and the teeth moving in the right directions and not allowed to backlash or "jiggle"*—the direct cause of unnecessary pain and of the destruction of tissue in tooth movement. I long ago pointed out and have since emphasized many times the fact that in the correction of malocclusion *the teeth should be moved directly and continuously from their malpositions into their correct positions without change of direction or more interruption of movement than is absolutely necessary, force for the purpose being firm, positive, steady and continuous.** In my opinion, all the force possible to be gained from the delicate arch of this mechanism can always be employed without increasing the rapidity of movement beyond the physiological limit, as I have said.

Let me make clear my position with regard to continuous force in tooth movement. Ideally, of course, the force would be positive and uninterrupted from the beginning to the completion of required movement of each individual tooth, and the movement would be as rapid as fully normal stimulation of bone cells warrants.

If force could be thus ideally applied, the requirements of physiology and dynamics would be fully met. However, no mechanism has yet been devised that admits of the exertion of the proper amount of force in all required directions to complete in all cases all necessary movements of all teeth from a single, initial adjustment. In fact this is rarely possible with the use of any mechanism available except in occasional simple cases of very young children, as in Fig. 15. So, after each adjustment, as soon as the force from the mechanism is spent or even before it is fully spent, the mechanism must again be so modified as to fully restore its activity. In the employment of this mechanism, as I have described it, the necessary interruptions to restore its activity need be but few and infrequent, even in complicated cases, a scientific advantage in the use of this over all other mechanisms with which I am familiar that can hardly be overestimated.

No mechanism for active treatment should ever be allowed to remain passive on the teeth after tooth movement is once begun, for retrograde movements, or backlashings, radically unphysiological and injurious, necessarily follow. Again, it should be the aim of all orthodontists to avoid the employment of force so slight as to be almost inoperative, but which not only permits but necessitates the jiggling of the teeth through the force of occlusion.

The reason for all this will be perfectly apparent to those who are truly familiar with the histology and physiology of the denture, namely, as I have said, that all interruptions in the movement of a tooth interfere with the physiological functions of the tissues and structures affected. In proportion to the extent and frequency of the interruptions, there are caused congestion, soreness, destruction of bone and, if protracted, a weakening of the tissues from which they do not readily recuperate and perhaps never wholly recover. Such deplorable results of treatment in violation of physiological cell stimulation are shown by many models and x-ray pictures in the

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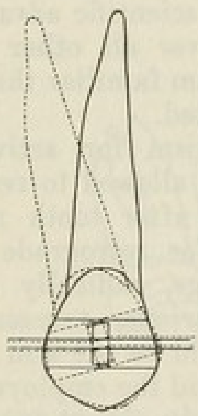
* "Malocclusion of the Teeth," seventh edition.

next room, the work of many orthodontists in widely separated fields. Indeed, such cases are brought to you and to this clinic almost daily for consultation.

In uprighting the buccal teeth *en phalanx* into their correct axial relations, I would emphasize the great importance of so making the bends in the metal arch that *equal force* will be exerted on each tooth. It should be very clear that otherwise the forces will conflict and the full, free, equal tipping of the teeth be obstructed. If the student will carefully study the mechanical principles involved in the uprighting of the teeth, as herein described, he must realize that the segment of arch between cuspid and anchor tooth becomes slightly lengthened as the teeth move and the bends in the arch

Fig. 39



straighten. Now, since the metal arch will be extended in a distal direction only, the anchor tooth will naturally be moved farther than the cuspid if the *bends* for each tooth are made *equal*. For this reason the bends should be greatest for the cuspids, gradually and very slightly decreasing toward the distal end of the arch.*

By referring to Fig. 39 it will be seen how pronounced would be the movement of crown or root (the movement of the root is shown in Fig. 39) by a very slight bend and compression of the arch within the bracket. I would therefore emphasize the fact that these uprighting bends should always be slight; *never greater than will permit the arch to be readily seated in the brackets with the fingers, when not more than a slightly snug feeling on the tooth should be caused.* The careless and most amateurs seem unable to comprehend this caution.

It would be excellent technical practice and discipline for students to determine mathematically the proportion of tooth movements to bends. The ratio of movement of the crown of a tooth to the proper bend in the arch will be found to be approximately as twenty to one. So important is accuracy in making these uprighting bends that all guesswork both as to their degree and their positions must be eliminated.

The arch being passively engaged on the teeth and the teeth having become tranquil after the preliminary adjustment of the mechanism, there are two plans of technique for making the bends for enlisting uprighting force from the arch, either of which may be followed. In pursuing the first plan, marks are made at the proper points on the arch anterior to the sheaths of the clamp bands, and staple spurs are soldered to the arch at these points. The arch is then replaced in the attachments and marked anterior and posterior to the bracket on the tooth next anterior to the sheath of the clamp band on one side of the dental arch only. The metal arch is then again removed and the occlusal and gingival bends, as previously directed, are made in it at the points marked. It is again replaced in all the attachments except that in direct relation to the last bends. Before attempting to spring the arch into this bracket the degree of the bends is carefully noted in comparison to the position of the walls of the bracket. If the bends are too great or unequal they should be corrected and the arch not seated until just the correct degree of obliqueness of that portion of the arch which is to engage the walls of the bracket has been attained, when the arch can be seated with the fingers alone. While thus seated the marks for the bends for the tooth next anterior are made as before, the arch removed, the bends made, the angle of the bends tested and the arch again seated, this time in

* Neff.

both brackets. This process is continued until the last bends, comparisons and final seating of the arch within the brackets, ending with that on the cuspid of the side worked upon, are satisfactorily completed.

If all the marks were to be made in the beginning of the operation it is evident that the bends would harmonize less and less with the positions of the brackets on the anterior teeth as they proceeded forward, or mesially, theoretically at least. For this reason the marking and bending for each bracket is proceeded with separately, as described.

In following the second plan we begin with the cuspids and proceed distally instead of mesially as before, but the same care must be observed in marking, bending, comparing and seating the arch in each bracket separately, each bend becoming very slightly less pronounced as we proceed distally. For reasons previously made clear, special care should be taken not to disturb the general alignment relations of the arch with its attachments; otherwise, unfavorable tooth movements and unnecessary cellular disturbance would follow. With the second method the spurs anterior to the anchor sheaths are omitted until, later, for other reasons, their presence may be desired.

I am now inclined to favor the second method, as a general rule, in preference to the first, although the technique of both should be perfectly familiar to the orthodontist and the method used that will best serve the purpose in individual instances.

Whatever the technique employed, active power is not necessarily enlisted on both sides of the dental arch at one appointment of the patient. Indeed, it is usually better for him to become accustomed to activity of the mechanism on one side at a time and usually, also, that power be renewed on one side at a time.

Another caution. Unnecessary elevation of the anchor teeth during the distal tipping of the buccal teeth is especially to be avoided. This is easily done by so shaping the metal arch that it will lie passively within the sheaths of the anchor bands while the bends for each bracket anterior to them are made in regular order, by either method as above directed. After all the bends have been satisfactorily completed and just before finally seating the arch, the necessary slight bends are made for effecting a downward pry on the distal end of the lower wall of the sheath of the band on the anchor tooth and a corresponding upward pry on the mesial end of its upper wall. In other words, there must be no *upward spring* in the metal arch which would tend to elevate the anchor teeth, but the arch must be so shaped as to effect only the *distal tipping* of these teeth.

The arch having been properly seated and power made active, as directed, for the distal tipping of the teeth *en phalanx,* it should remain uninterruptedly active for two or three weeks. It should then be most carefully removed without disturbing its form, when the bends may be gone over and increased, extreme care being taken to make the increase *very slight* and proportioned exactly to the original bends, the amount of increase not exceeding what would be equivalent to the thickness of a piece of ordinary writing paper in any instance. Also each individual increased bend must be compared with the angle of the walls of its respective bracket, as previously discussed, before the arch is again seated.

Only a very few such changes are required, even in extreme cases, and it is surprising how easily, effectively, painlessly and promptly the movements may

Fig. 40

be accomplished, and too, in most instances, by the use of the delicate round arch alone. In this use of the arch is beautifully illustrated how effectively power can be made reciprocally active.

Of course the same uprighting or tipping force may be gained in the use of the ribbon arch, with its cleat and bracket connections, by which means we have long been uprighting single teeth and reinforcing the anchorage secured from a number of contiguous teeth, as in Fig. 40. Also, the teeth may be placed upright *en phalanx* simply by changing the angles of bearing of the cleats, either by suitable bends in the arch bar or a slight bend in the longer leg of each cleat.* Or, of course, new cleats may be substituted, these being attached at such angles as to properly bind on the brackets and cause the necessary distal tipping of the teeth. Although this is effective, yet in ease of power control the new mechanism is far superior.

STABILIZATION OF ANCHORAGE

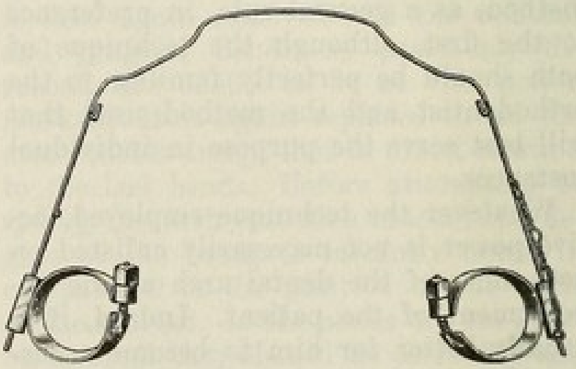
Every practical means of adding to the stability of anchorage in the use of orthodontic mechanism unquestionably means progress in the science as a whole. Only a little while ago we were almost wholly limited to simple anchorage alone. Then was added occipital anchorage, then stationary anchorage, and finally intermaxillary anchorage. Now, with this new means of power control in the uprighting of teeth, we have added still further to our present considerable anchorage resources in a simple, practical and very effective way, that is, by increasing and stabilizing static power in the anchorages previously relied upon alone.

This is something of such importance that all will appreciate it. Orthodontists have often felt this need, especially in the treatment of cases belonging to Class II. The modern, correct treatment of these cases demands the pronounced distal movement *en phalanx* of the teeth of the upper arch in order that they may be in fully normal cusp relationship with those of the lower arch. This should be done without mesial movement of the lower teeth (even though intermaxillary anchorage be employed), and without mesial displacement of the mandible from the normal, habitual relations of its condyles in the glenoid fossæ as manifest in the act of swallowing. The importance of avoiding mesial displacement of the mandible in the treatment of these cases has been ably emphasized by Dr. Cecil C. Steiner in a paper recently read before this Society and soon to be published.

If I have made clear the technique of the use of this mechanism for uprighting teeth you will readily comprehend that not only may upper teeth be thus moved in these cases (Class II), but that lower teeth, used as anchorage through intermaxillary attachments, may be prevented from moving mesially *and even themselves tipped backwardly and upwardly at the same time that the upper teeth are being so moved,* as is often required.

It may be well to mention here that in reducing extreme prominence of central incisors, in beginning the treatment of cases belonging to Class II, Division 1, it will be found of advantage to use a turnbuckle form of ligature in addition to the intermaxillary elastics. Of course an ideally shaped metal arch will be used which may be either round, as in Fig. 41, or round edgewise, as in Fig. 47, the turnbuckle ligature engaging the distal end of the sheath of the anchor band and a hook-like spur attached by solder to the

Fig. 41



arch approximately half an inch anterior to the mesial end of the sheath, as shown on the right in Fig. 41, or engaging the sheath and a staple attached to the arch, as shown on the left of the engraving.

It will be understood that the ends of the arch must be so shaped as at the same

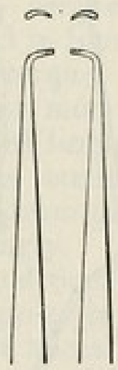
* Atkinson.

time to exert a distal, uprighting pry on the anchor teeth. The advantage of the additional power to be gained in the use of the turnbuckle ligature is that there is thus made active the full spring of the middle segment of the metal arch, and that the metal arch, by being pulled distally, is narrowed in the region of the cuspids so that there is less interference with the cheeks and lips.

An elastic ligature might be used instead of the wire turnbuckle, but it would be more bulky, less cleanly and less efficient and steady in the control of force between anchorage and incisors.

Ligature wire of the smallest size only is used for the turnbuckle, and instead of uniting its firmly drawn together ends by means of a twist, they are firmly tied

FIG. 42

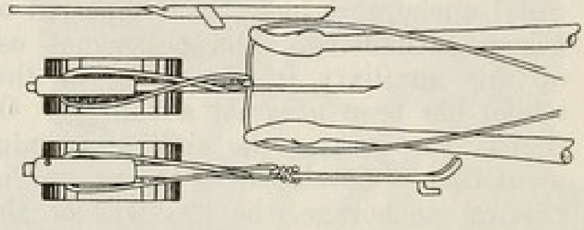


in a square knot, the superfluous portions then being cut away very close to the knot. The subsequent twisting of the ligature in turnbuckle fashion is difficult or impossible unless done by means of two (right and left) delicate-end instruments. Those best suited for the purpose that I have so far found are excavators Nos. 44 and 45 (Fig. 42).

If you will skill yourselves in the technique of this method of supplementing force for the purpose indicated so that you can adjust and operate the ligatures neatly and effectively, you will be delighted with it. If not, it will not give you satisfaction.

Force thus gained must be operative only in the beginning of treatment and not longer than for two or three weeks at most. Otherwise the anchor teeth will be dragged forward, when correct treatment of cases such as this usually demands, as you know, their pronounced distal movement, accompanied through intermaxillary force plus that derived from uprighting bends in the metal arch and the use of spurs, washers, etc., as fully explained elsewhere in this paper.

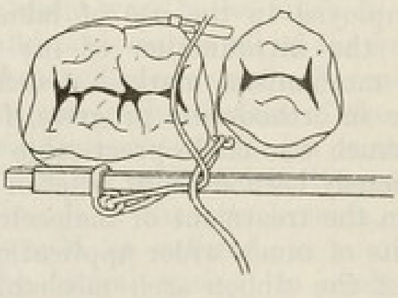
FIG. 43



Another way of retracting the metal arch with the ligature, which is drawn tight by means of the ligature-locking pliers, is shown in Fig. 43.

The wire ligature may also be used effectively and in a very compact manner for extending the metal arch forward, or moving it in the opposite direction to that illustrated. It is shown in Fig. 44 and was suggested by Dr. W. E. Wilson. A strong spur is soldered to the anchor band well forward and in the embrasial space. One of the little staples (E, Fig. 2) is soldered to the metal arch just anterior to the sheath

FIG. 44



and the ligature is then made to engage the staple and spur, drawn moderately tightly, and locked by means of the ligature-locking pliers. It must be remembered that when so used the sheath must be attached well distally on the band, for obvious reasons.

With the tremendous progress that has

been made in gaining effective anchorage, it would seem that occipital anchorage* could now be entirely dispensed with, as I once believed possible. But I am convinced that in very complicated cases, such as often greatly tax the skill and ingenuity of the orthodontist, the headgear, traction bar and heavy elastic bands always have a place as an anchorage auxiliary and should be used promptly when indicated, or before the usual anchorages have been impaired or become exhausted. The occasional use of this auxiliary in the clinic of this school has been of great advantage. Of course, the greater the skill and judgment that is developed in the use of intra-oral anchorage, the less will be the need for anchorages of extra-oral form.

TORQUE POWER IN THE METAL ARCH

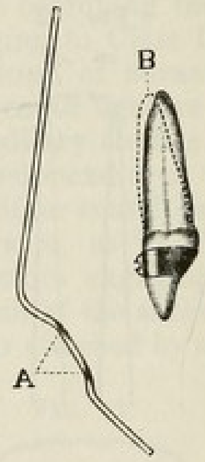
So far we have considered the enlisting of force in the use of this mechanism by means of two distinct forms of bends in its metal arch for effecting the two orders of crown movement heretofore discussed. There still remains latent in the arch an additional power, in the employment of which are great possibilities for effecting other distinctive tooth movements. This power may easily be gained by means of a third form of bend which is entirely distinct from the other two.

This power, practically unknown and unemployed in the use of labial arches until the introduction of my pin-and-tube mechanism, marked a definite advance in orthodontic progress, for by its use much was made practicable that had previously been difficult or even impossible in the treatment of malocclusion. It admits of much wider application in the use of the ribbon arch mechanism, and the power, as used with this new mechanism, is even more practicable and valuable, because it has greatly extended the limits of treatment by making root or crown movement lingually or labially or buccally far more easily possible than heretofore. When thus used the power in the arch does not seem to be lessened for the purposes previously described. There are also still further advantages in its use that will be discussed later.

For clearness and convenience of description we shall call this the torque power, for it is that force or power which is to be derived from the tendency of the metal arch, by reason of its elasticity, to untwist after it has been slightly twisted or torqued on itself in the direction of its long axis.

To illustrate the use of the torque power in the simplest form: If the labial root movement of an upper lateral incisor is desired it is effected by making two slight twists in the metal arch, one

Fig. 45



anterior and one posterior to the bracket on this tooth (A, Fig. 45), the portion within the bracket being made to flare downwardly at its outer lower edge and upwardly at its upper inner edge. The force from the twist would thus be reacted between the walls of the bracket when the arch was seated therein and deflected to the root of the tooth, causing the outward or labial movement of the apex of the root (B, Fig. 45) without moving the crown. The twist would of course be made in the opposite direction if the lingual movement of the root of an upper tooth or the labial movement of the root of a lower tooth were desired, but in the same direction for the lingual movement of a lower tooth root.

* Malocclusion of the Teeth and Fractures of the Maxillæ," sixth edition.

In order to distinguish these from the bends in the arch previously discussed we shall call them the torque bends, because their purpose is to enlist the elastic torque power in the metal arch. And it is to be distinctly understood that these bends must be made *without in the least changing or disturbing either the horizontal or perpendicular planes of the metal arch anterior and posterior to them.*

The static control of torque force thus secured is of course gained through the rigidity of the bracket and sheath attachments elsewhere in the dental arch, and without in any way interfering with the direction or control of force in operation for other desired tooth movements.

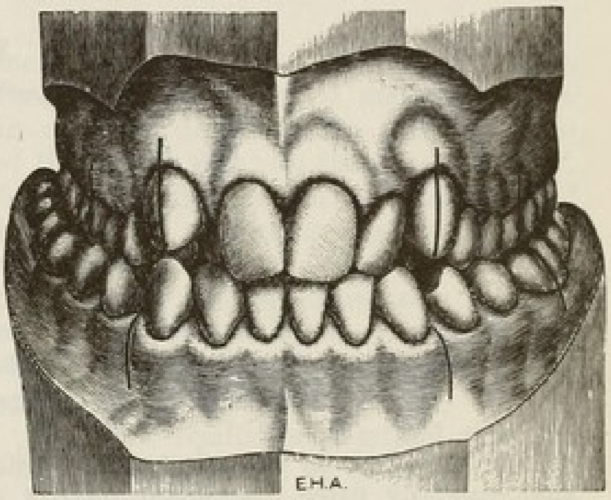
Of course if two or even all of the roots of incisors required lingual or labial movement, torque power for all would be enlisted in like manner through similar slight torque bends for each tooth. Or one or more roots might require to be moved lingually and another or others of the same dental arch labially, the force from torque bends being directed accordingly.

It will be found that the torque power in this mechanism to be enlisted for lingual or labial or buccal root movements is ample and may be under positive, complete control, but I would caution that care be taken not to carry these movements too far. There is, however, no danger of performing them too rapidly with power so exerted, if the power is made to act continuously. The torque power may also be enlisted, often to great advantage, for reinforcing the usual forms of anchorage, especially that employed in the treatment of cases belonging to Class II.

And it has also another very important and practical application, namely, that of reinforcing the usual power derived from the lateral spring of the metal arch for widening or narrowing dental arches, for example, in the required pronounced movements of such cases as that shown at Fig. 46.

Let us suppose that the correct form of the upper metal arch had been determined and the arch seated in all the necessary attachments, exactly as previously described. It is easy to understand that the usual lateral spring in the metal arch would thus be enlisted for widening the dental arch, just as has long been

Fig. 46



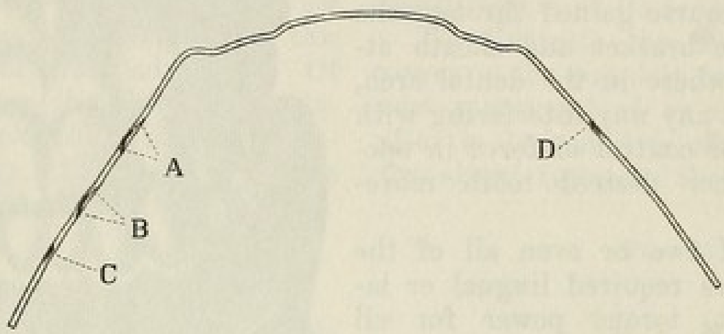
done in the use of the expansion arch E.* And, be it remembered, the arch of this new mechanism being bent edgewise, the power to be exerted by it in a lateral direction is much greater than if it were round or of ribbon form of the same weight of metal. Now it will be readily understood that if, without disturbing its horizontal and vertical planes, torque bends were to be made in it anterior and posterior to all of the brackets of the bracket bands on the buccal teeth and anterior to the sheaths of the clamp bands on the anchor teeth (as on the left, A, B, C, in Fig. 47), and if it were again seated in all of the attachments, torque power would be enlisted, in connection with the lateral spring, to exert force outwardly, or buccally, upon the crowns of the buccal teeth and to exert force, without movement, inwardly, or lingually, on their roots, for these roots remain static through their firm attachments to the alveolar process and peri-

* "Malocclusion of the Teeth," seventh edition.

dental membrane. Torque power is thus reacted through them to the crowns, being transmitted along the line of least resistance. The force from the lateral spring already in the arch for the buccal tipping of the buccal tooth crowns and the widening of the dental arch would thus be greatly supplemented. In other words, there would be two forces enlisted: first, that from the lateral spring of the metal arch; second, a perpendicular rotating force, the latter having a tendency to tip or roll, so to speak, the crowns buccally out of inlock.

Of course it will be understood that one torque bend, as on the right (D, Fig. 47), anterior to two or three buccal teeth that might require to be tipped outwardly, would produce the same result as if anterior and posterior torque bends were made for each of the two or three individual teeth, as shown on the left in the illustration; that is, the same degree of torque power would be obtained for the movement of the teeth on the right and much more simply. It will be noted in the illustration that the general planes of the side and edge surfaces of the metal arch anterior and posterior to the torque bends have not been in the least altered.

Fig. 47



So effective is this torque power that when properly employed it will more than double the effect of the lateral spring of the metal arch alone for widening dental arches. And of course it is obvious that, if made active in the opposite direction, it could be enlisted to assist in narrowing dental arches, as required in the lower arch in the case shown at Fig. 46.

If the manner of enlisting torque power for the lingual or buccal movement of roots of teeth and as an auxiliary to the movement of their crowns is understood, it will be realized how effectively this power may be employed in those troublesome and by no means infrequent cases in which the teeth of one lateral half only of an upper dental arch are inlocked in their relations to the opposing lower teeth, or in full lingual occlusion—usually the result of hand or pillow pressure habitually exerted by the patient on the denture during sleep or when awake or both.

Now teeth in these malrelations are more difficult to move than those in ordinary malpositions because of the resistance offered by the inclined occlusal planes of the opposing lower teeth.* This resistance even outweighs the usual anchorage to be gained from the opposite or normal side of the upper dental arch. But by enlisting the torque power, as above described, to augment the usual lateral spring of the metal arch for the buccal or outward movement of the crowns of the inlocked teeth, the danger of overloading the anchorage on the normal side is greatly lessened. And even anchorage from the normal side can be enormously strengthened by also enlisting torque power in the opposite direction on this side, for it will be reacted upon the roots of the anchor teeth and the result will be stationary anchorage.†

In this way ample power under complete control is afforded for the treatment of these often perplexing cases, for the torque power is made operative in opposite directions on the two sides of the dental arch: on the abnormal side, for the outward or buccal movement of the inlocked crowns through simple anchorage and the free tipping movement of the teeth; on the other side, for the outward movement of the roots only, the effect, as I have said, being stationary anchorage on this side.

You will readily understand that the same principle may be employed to simultaneously tip and roll out of inlock a single molar tooth, a movement often required and by no means easy of accomplishment with the limited anchorage to be gained in the use of ordinary orthodontic mechanism, a difficulty to which all can testify.

An additional force to assist in moving such a tooth from its malposition is also sometimes available, namely, by projecting the end of the metal arch through the sheath of the clamp band sufficiently to bear against the buccal surface of the distally adjoining tooth, should one be present.

How simply and practically force in the required amounts and directions for anchorage and for effecting the desired movement of teeth may thus be gained and controlled for the treatment of all forms of these troublesome cases should now be clear, but the importance of accuracy in making the torque bends in the arch and of care in seating the arch within the sheaths, brackets, etc., must be emphasized.

It cannot be too often repeated that success in the use of this mechanism depends absolutely on the care, accuracy

* "Malocclusion of the Teeth," seventh edition.

† "Malocclusion of the Teeth and Fractures of the Maxillæ," sixth edition.

and skill with which its technical operations are performed. But I also repeat that these require only such degree of skill as any one of average ability can easily develop with a little careful self-discipline and the exercise of reason, and without such skill no one has any right to undertake the practice of orthodontia.

It should be plain to all by this time that there is no royal road to success in orthodontic treatment, but that success is attained only through clearly recognizing and complying with the readily to be discerned laws of dynamics and physiology, the cause of failure, in a large percentage of cases, being directly traceable to lack of understanding of and compliance with these laws.

The orthodontist who is always complaining of mechanism being "too complicated" is only attempting to excuse his own ignorance or innate incompetence. And, strangely enough, it is usually these same individuals who themselves complicate really simple mechanisms.

The employment of the new mechanism in cases in which force is to be exerted for tooth movements of the first order alone is very simple and easy. It is probably by far the easiest of all rational modern mechanisms to so apply and operate. But with the addition of the vertical bends in the metal arch for tooth movements of the second order—the mesiodistal uprighting of teeth—and with the further addition of the torque bends for enlisting the torque power, there are, of course, some added complications, for it is a law throughout nature that if decided advantages are gained in any certain direction, some form of compensation must be made. Fortunately, in this case, the penalty to be paid is very inconsiderable and is in reality a blessing in disguise, for it results in real growth in skill and judgment.

If the student will keep clearly in mind the distinctions in the derivation of force for each order of movement and will observe care in the extent and purpose of the respective bends in the metal arch with relation to the respective attachments, he will soon learn to make intelligently, easily, quickly and accurately all the necessary bends and the subsequent changes in the mechanism which may be required in daily practice.

Although having quite carefully considered ways and means of force control in correcting malocclusion of the teeth, I should still have failed in the discharge of my full duty if I neglected to emphasize again the extreme importance of giving close attention to the various specific causes of the malocclusion in each given case. Every case should be most carefully studied until the single cause or collective causes that are responsible for the conditions, as presented, are definitely known; what treatment, in addition to that which is merely mechanical, will be required; and what is the prognosis of the case.

Lesions of the throat and nose have been so often and so ably discussed that early attention to these is now recognized by all true orthodontists as a necessary standard requirement of treatment. But causes that are far more common and equally pernicious, such as abnormal lip, cheek and finger habits, are all too often winked at or even wholly unrecognized by orthodontists, although their correction during the course of treatment is equally demanded with that of the malocclusion.

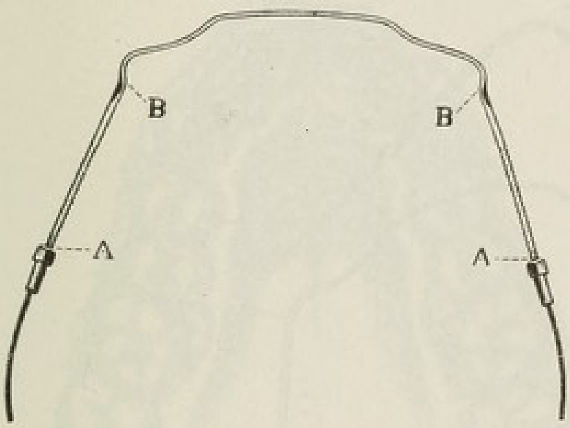
In this connection I would strongly recommend the careful study of a paper* by Dr. W. E. Wilson, who has given the subject of abnormal habits of facial muscles long and thoughtful attention and who has probably worked out the best technique for their correction that has so far been evolved.

Having made clear how universally applicable the new mechanism is and its wonderful possibilities for power control in all required movements of all teeth in cases from the simplest to the most complex types, I would add briefly a description of how we may even combine this mechanism with the ribbon arch

* "Common Perversions of the Functions of Facial Muscles, with Practical Methods for Their Correction." DENTAL COSMOS, April 1927.

mechanism with value in some instances, especially to the ribbon arch mechanism.* For example, when the anterior teeth are comparatively regular in their arrangement, we may use on them the well-known standard reinforced bands with perpendicular-slot brackets of the ribbon arch mechanism, and open-face, horizontal-slot brackets (brackets No. 2) of the new mechanism on the buccal teeth. Standard anchor clamp bands with curvilinear sheaths would be placed on the anchor teeth, and the standard ribbon arch with screw adjustment used. This arch can easily be made adaptable to the two types of bracket simply by

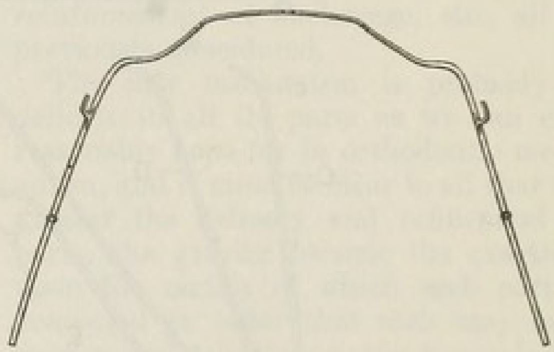
FIG. 48



making in it a one-fourth twist anterior to the nuts (A A, Fig. 48) and another one-fourth twist between cuspid and lateral on each side (B B, Fig. 48). The buccal portions of the arch between each two twists would then lie edgewise to the teeth, as shown in the illustration, and could be engaged in horizontal-slot brackets (brackets No. 2) on the cuspids and buccal teeth, while the anterior part of the arch would engage the standard perpendicular-slot brackets of the ribbon arch mechanism and be secured by pins in the usual way. And of course, instead, the tiny ribbon arch may be used in the same manner, with rectangular sheaths on the anchor teeth, as in F, Fig. 3. But it should be obvious that where there is pronounced malarrangement of incisors, as in Figs. 16, 18 and 35, the force for the movement of individual teeth would be far more directly and efficiently controlled by the use of ligatures, horizontally slotted brackets (brackets No. 1), and an ideally formed metal arch, as in A, Fig. 14.

Lastly, I have been carefully testing out another type of arch which promises

FIG. 49



very gratifying results, for in certain instances it will make the application and readjustment of the metal arch easier, without reducing its efficiency. This arch is a combination of the edgewise and round arches, as shown in Fig. 49, that is, the anterior segment is of the round arch material and the lateral segments of the edgewise material.

There are a number of ways in which the two materials might be joined, but the quickest and simplest and the one insuring the greatest accuracy, as well as being the most economical, is to start with one of the long bars of the round arch material just as it comes to us from the manufacturers. From this the middle or anterior segment is made. In order that this segment may be of the proper length, the bar of metal is laid on the measurement dots of the case in hand, A, Fig. 50 (also shown at A, Fig. 11), one end resting at the point indicating the proximal contact point between

* It has been fully demonstrated, however, that the student who masters this new mechanism and confines himself strictly to its use becomes more skilful in the treatment of cases, hence completes them more quickly, easily and satisfactorily, than does he who adopts any other method or combination of methods, for the reason that the new, intelligently understood and properly operated, accords more closely with the laws of dynamics and physiology than do any others alone or in combinations.

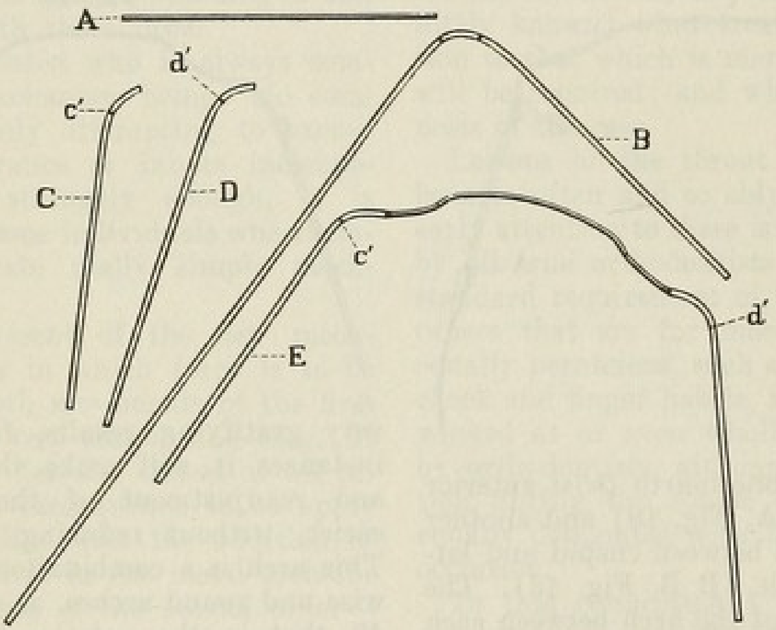
cuspid and lateral incisor on one side (C, Fig. 11), the like point between cuspid and lateral on the other side (C′, Fig. 11), being marked by a sawing movement with a sharp knife. The bar is then cut off at this latter point and the ends squared, as shown in A, Fig. 50.

The lateral segments are made by first giving the rectangular bar an edgewise bend in the groove of the smallest step of the arch former, the result being shown at B, Fig. 50. Each is then in turn laid on the measurement dots and distinctly marked at the points representing, first, the point of proximal contact between cuspid and lateral incisor, and second, the center of the labial ridge of the cuspid on each side, then cut off at the former point. This stage is shown at B, C and D, Fig. 50. After carefully squaring the ends of both lateral segments they are united with the middle segment. A No. 2 disk of solder (Fig. 33) is partially fused on each end of the middle segment and the lateral segments are then joined to the middle segment by freehand soldering in the usual way. The arch, thus completed, is then shaped in accordance with the technique given, beginning on page 1154 of the December 1928 Dental Cosmos. The result is shown at E, Fig. 50.

The length of the lateral segments from the bend to the points at which they are cut off the bar must, of course, correspond to the predetermined length demanded by the case in hand.

Doubtless in some instances it will be of advantage to reverse the order of the segments, making the middle segment of the edgewise material and the lateral segments of the round material, in order that torque power for incisor root movement or for reinforcement of anchorage may be enlisted.

Fig. 50



The combination arch, composed of a round middle segment and edgewise lateral segments, with standard ribbon arch brackets on the anterior teeth, as shown in A and B, Fig. 51, will be found to work very satisfactorily on occasion. Furthermore, even in cases of very irregularly arranged incisors on which such bracket bands may be employed, as in this case, if delicate staples are attached to each of the two labial angles of the bands and the ligatures are made to engage them and the metal arch, as in the manner previously described in the use of No. 2 open-face brackets, the greatly malposed teeth may be brought into more normal arrangement so that the ideally formed arch can then be engaged with all of the brackets without the complication of the sharp bends necessary in the use of the ribbon arch mechanism. In this way there are advantageously combined some of the

FIG. 51A

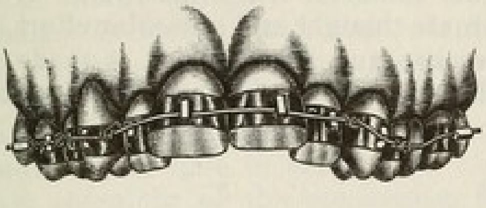
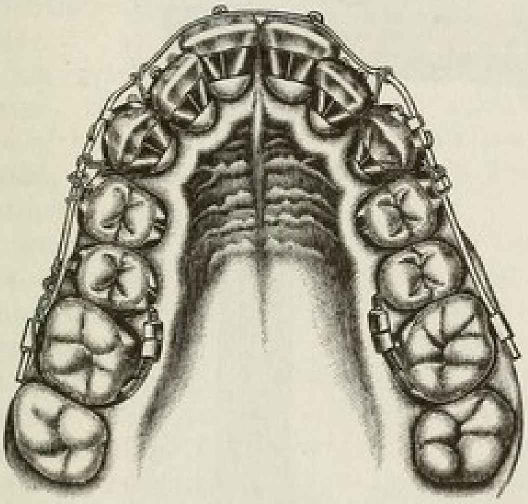


FIG. 51B



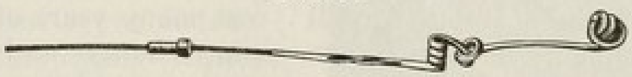
valuable qualities of both mechanisms, something that I believe will be appreciated by ribbon arch enthusiasts.

In cases in which a tooth or contiguous teeth are unerupted or missing, leaving a long space between attachments to be spanned by the metal arch, the latter, whether round or rectangular, must be reinforced or strengthened in this region to prevent its being bent under the force of mastication. This should be done by soldering lengthwise to the gingival surface of the arch an additional strip of the arch material of sufficient length to span the space. Or the edgewise arch may be strengthened by giving it the quarter twists previously referred to, just anterior and posterior to the space, thus changing its wider plane from horizontal to perpendicular.

In nearly all instances I prefer the delicate round arch, ideally formed, in beginning treatment, on account of its delicacy, adaptability, greater range of elasticity and the greater ease of its original application. Later, a change may be made to the edgewise arch, Fig. 35, or to some form of combination arch as just described, if torque power is needed or greater power for widening or narrowing dental arches, difficult uprighting of teeth, lingual or labial root movements, reinforcement of anchorage, etc., all as previously considered.

The new mechanism is probably as delicate in all its parts as we can ever reasonably hope for in orthodontic mechanism, and it must be clear to all that the greater the delicacy and refinement of parts, the greater become the exactions upon the metals of which each part is composed in order that each may meet most completely the specific demands imposed upon it in practical use. After years of careful effort and painstaking research the manufacturers have produced metals which seem to me to be all that we can reasonably expect. Especially am I pleased with the arch material, with its remarkable elasticity, toughness and strength, and the ease with which its elasticity may be restored after the application of heat in making attachments to it. Figure 52 shows one of these arches a portion of which has been wound into a tight coil and another portion even tied in a knot. From careful experimenting I know that many of the imitations of these metals fall far short, in practical use, of true orthodontic requirements.

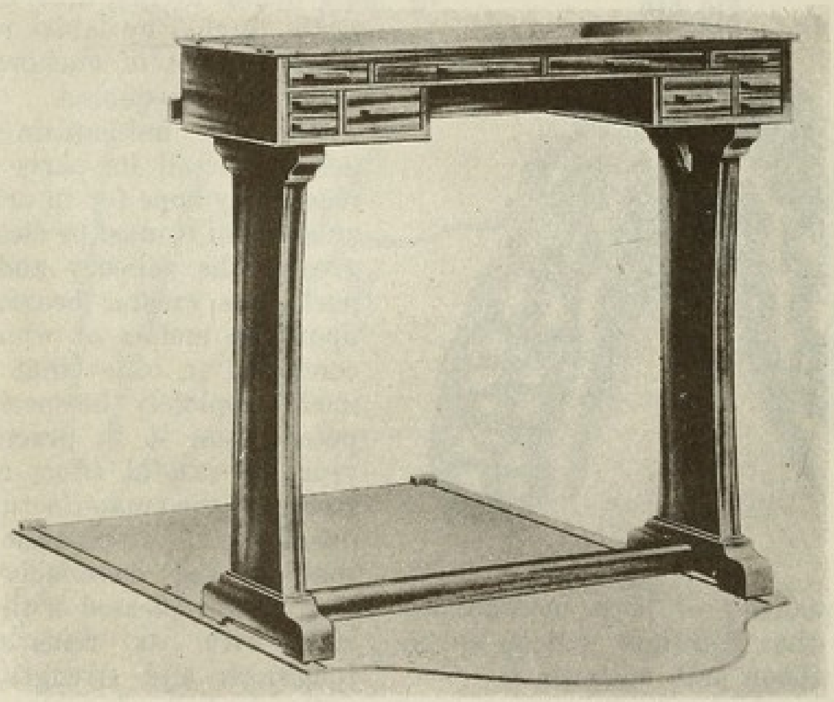
FIG. 52



Finally, let me earnestly advise you to

keep fully up to date with regard to the quality and condition of your instruments and equipment. Without the best you cannot attain that ease, joy and satisfaction in your work which is so essential to the highest success. To this end I have recently added certain improvements and refinements to that most useful of all adjuncts to the orthodontist's working equipment, the work-table (Fig. 53). These I think you will all appreciate. First, there has been created more space for the knees of the patient when the chair is elevated; second, six more little drawers have been added without increasing either the bulk or the weight of the table. The additional drawers afford a superabundance of room for all stock, tools, instruments, etc., that can possibly be required. There has also been added a hidden shelf, conveniently placed at the back of the table, for holding the cement slab, bottles, soldering-lamp, etc., which are thus wholly out of the way and out of sight when not in use. The casters and track have also been so improved that the touch of one finger on the glass top of the table readily effects its movement backward or forward, so the operator soon learns to adjust the position of the table to his direct needs unconsciously, and always has his instruments in the handiest possible relation to his work. His mind, therefore, is not distracted from the work in hand through searching for needed instruments in drawers of cabinets remotely located. By being thus able to concentrate and to coördinate thought and muscular effort, much quicker and better work is made possible. These late improvements also give better balance and add greatly to the beauty as well as to the efficiency of the table, and you will pardon me if I tell you that I have much pride in it. It has cost many years of careful thought, and many changes and refinements have been necessary to bring it to its present state.

Fig. 53



CASE REPORTS

In view of all I have previously published it would seem unnecessary to repeat here minute directions for the specific treatment of cases belonging to the three great classes of malocclusion, their divisions and subdivisions. Following correct diagnoses the requirements of treatment are self-evident and the necessary tooth movements clearly indicated, with means, as herein outlined, for their practical, complete and prompt accomplishment in harmony with the physiological demands of the tissues involved. The beautiful results attained in treatment of many difficult cases by this mechanism exclusively will illustrate my point. A few of these cases I shall now show on the screen, and you will bear in mind that all of this work was done by students now here in our school, who did not complain of the mechanism as being "too complicated" for their comprehension or too difficult for them to master.

I am especially proud of these results because, before coming to this school, none of these students, with but one exception, had had any experience in the treatment of malocclusion.

I would ask you to compare the results of their work with that of any orthodontist, even that of well-known older so-called experts, especially those who pride themselves on and strenuously advocate "slow treatment,"* or periods of treatment of from four to six years' duration and which, as you know, often last far longer—six, eight and even thirteen years, and some even indefinitely. And these, remember, are only the periods of *active* treatment and do not include retention—another story which I may touch on at a later session. Judging from that which still remains to be accomplished in active treatment alone in many cases which come to you and to us here, it is reasonable to suppose that most of the patients will reach a ripe old age before retention is concluded.

Although I am thoroughly familiar with every step in the progress of treatment of all the cases I shall show, I shall not give detailed descriptions of any of them, for obvious reasons leaving this to those who conducted the work.† They have prepared models, slides, study models, x-ray pictures, etc., which thoroughly illustrate the various steps in the treatment of each case and the changes that were brought about in treatment, not only in the positions of the teeth but

Fig. 54

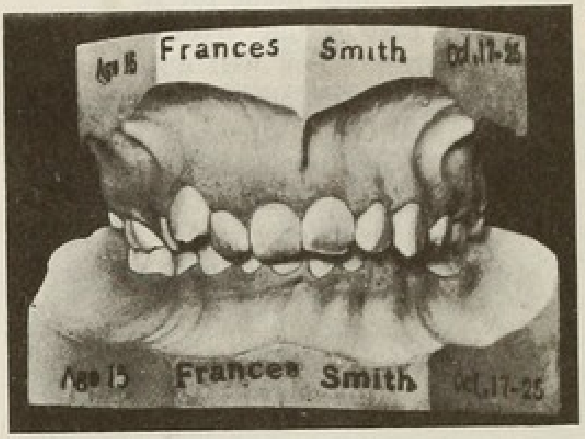
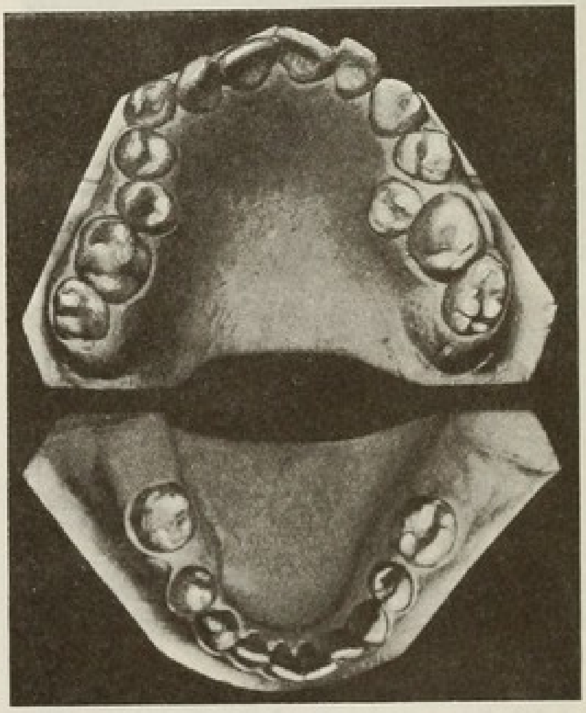


Fig. 55



* Note the profound discussion of this question in the report of the Round Table Discussion, Table No. 5, published in the *International Journal of Orthodontia*, July 1927.

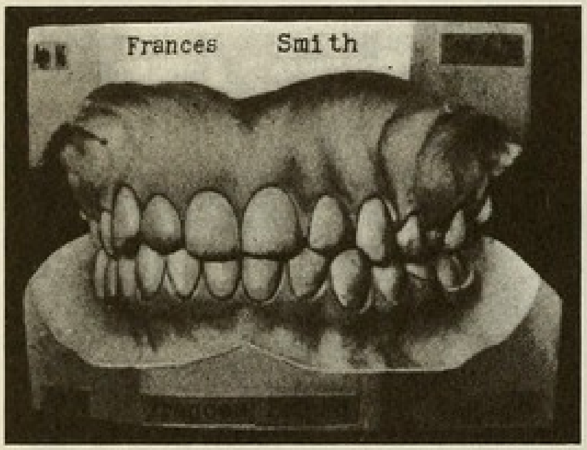
† The reports of these and other cases will later be published by the students themselves, as will, also, the reports of other cases similarly treated by well-known practitioners of orthodontia and members of this Society, notably Drs. W. E. Wilson, Roscoe A. Day, J. Howard Furby and George C. Chuck.

in the tissues affected. These they will show you. My part now is only to show what can be and has been done with the new mechanism when employed exactly as I have outlined to you today, in proof of the claims I have made for it.

The first case is one treated by Dr. Mary N. Bercea. You will note that it belongs to Class I and that it is of a type by no means simple. The arches are greatly shortened and all of the second bicuspids have been forced to erupt into pronounced lingual occlusion, with the usual bunching and overlapping of the anterior teeth.

The original models of the case are shown in Figs. 54 and 55 and those after the completion of active treatment

Fig. 56



in Fig. 56. The dates of the beginning and completion of active treatment are indicated on the models, from which you will see that the time consumed was a little less than eleven months.

The gratifying results, which you will later have an opportunity to examine in the mouth of the patient herself, are clearly apparent not only in the occlusion, but also, very naturally, in the features of the young lady.

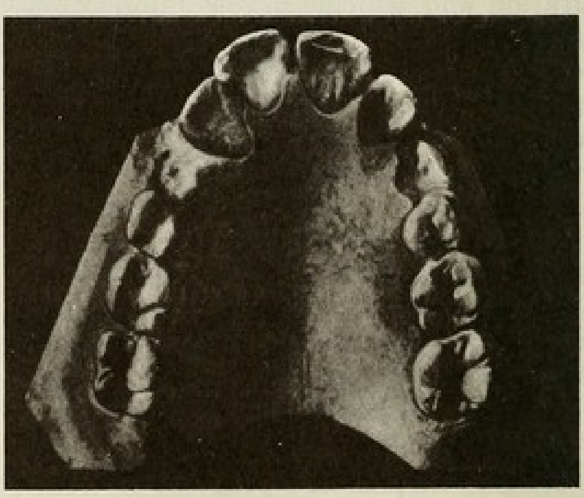
The next case, illustrated in Figs. 57 and 58, is a pronounced, typical example of Class II, division 1, and was treated by Mr. F. Ishii, the second case of this description treated with this new mechanism and the second case of malocclusion to be treated by Mr. Ishii. A fact to be noted in this connection is that this young man had never studied in a dental college nor made any study of the human denture before coming to our school.

I think you will have no difficulty in

Fig. 57

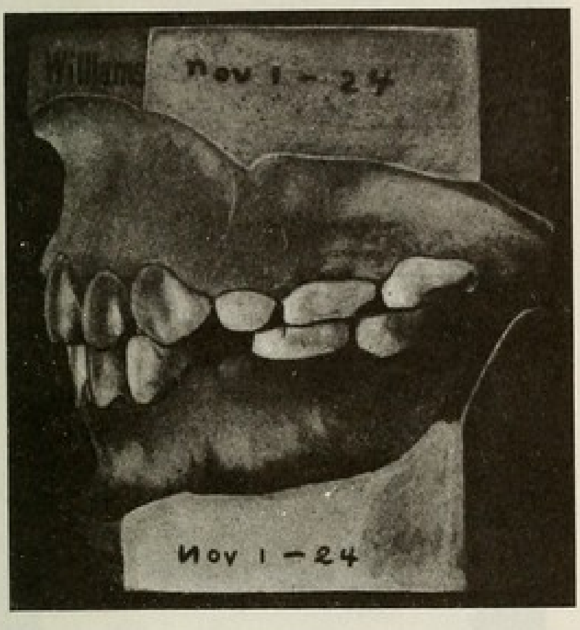
recognizing the case as a fully developed, typical deformity of the kind. And I would add that the cause was painfully apparent, namely, abnormal finger and lip habits, begun very early and most faithfully persisted in.

Fig. 58



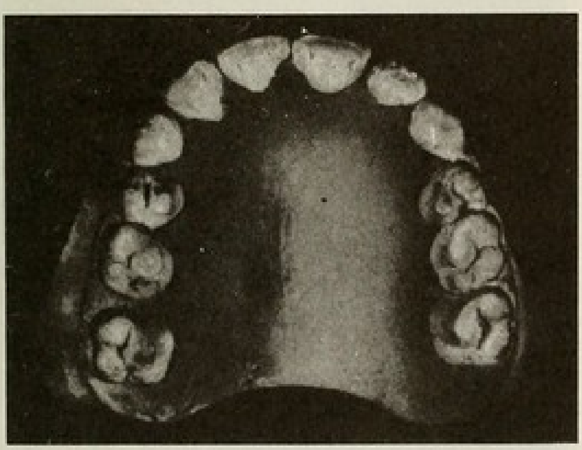
In connection with the usual required movements of the first order, necessary in shortening and widening the upper dental arch, there has been accomplished the full restoration of all of the upper teeth to their normal positions of uprightness through movements of the second order, or the distal tipping of the crowns of the teeth, described in connection with the second order of tooth movements and illustrated in Figs. 59 and 60, and all in a very little over five months,

FIG. 59



as the dates show. You will note later the splendid condition of the tissues that have been operated upon, together with the patient's joyous expression over the

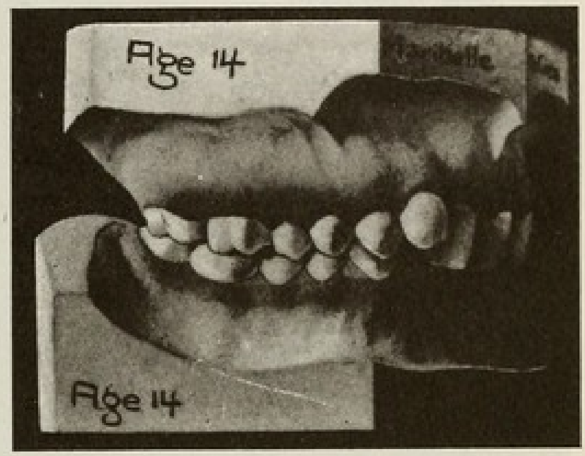
FIG. 60



marvelous changes that have been wrought in the contour of her face.

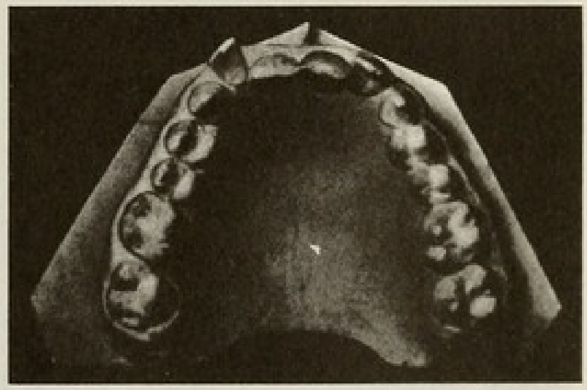
Figures 61 and 62 show a very pronounced, typical case belonging to Class 11, Division 2, and Figs. 63 and 64 show the truly beautiful results attained. This case was treated by the late Dr. Edwin Kanter and was, I believe, his very first orthodontic case here or elsewhere. I know of no nicer result in the treatment of this well-known distinct

FIG. 61



type of malocclusion in all literature, and I would ask you to note how completely the second as well as the first order of movements has been accomplished; also the length of the period of active treatment—four and one-half months. When this case is reported you will see from the x-ray pictures in what

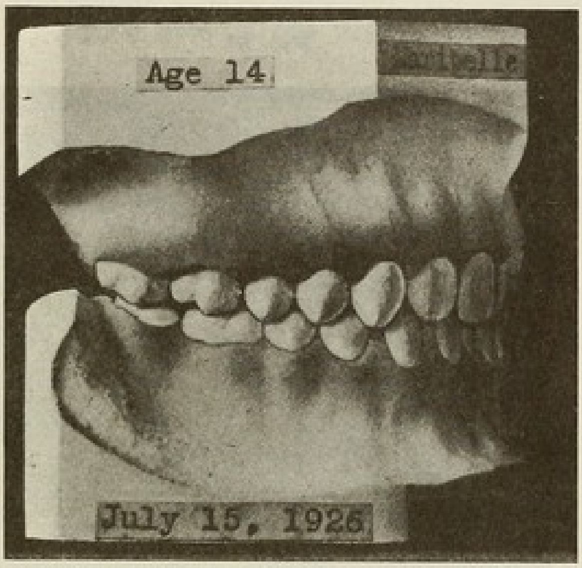
FIG. 62



excellent condition the peridental membrane and alveolar structures are.

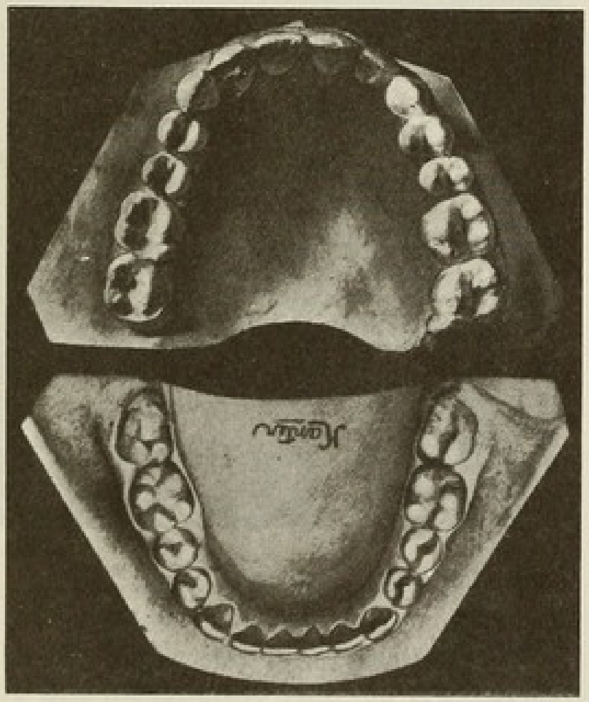
We now come to a case which you will all agree is not only complicated and difficult of treatment, but even impossible of proper treatment with the types of mechanism usually employed. It is an extreme case belonging to Class I, rapidly developing into a subdivision of Class II, Division 2, and is illustrated in Figs. 65, 66 and 67.

Fig. 63



In addition to the pronounced malarrangement of the teeth of both jaws you will note how greatly out of harmony

Fig. 64



are their axial relations, due to the extreme mesial inclination or tipping forward of their crowns, particularly as

Fig. 65

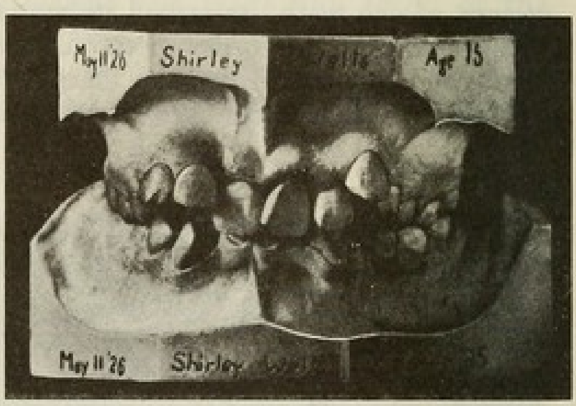


Fig. 66

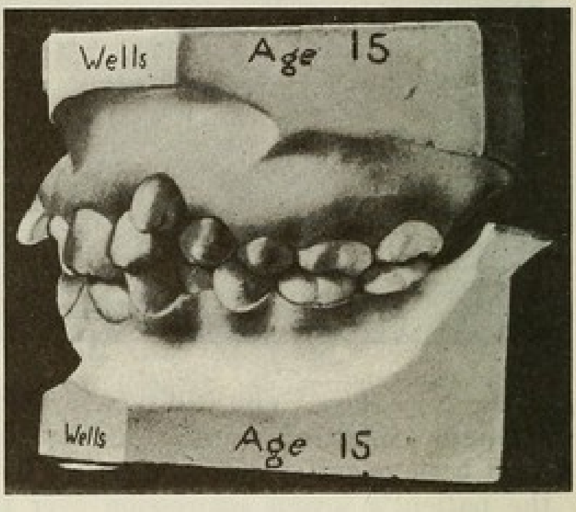
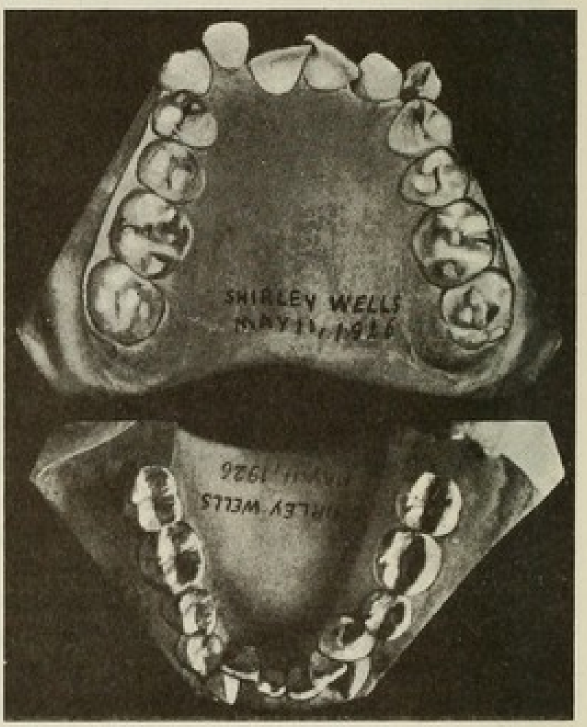
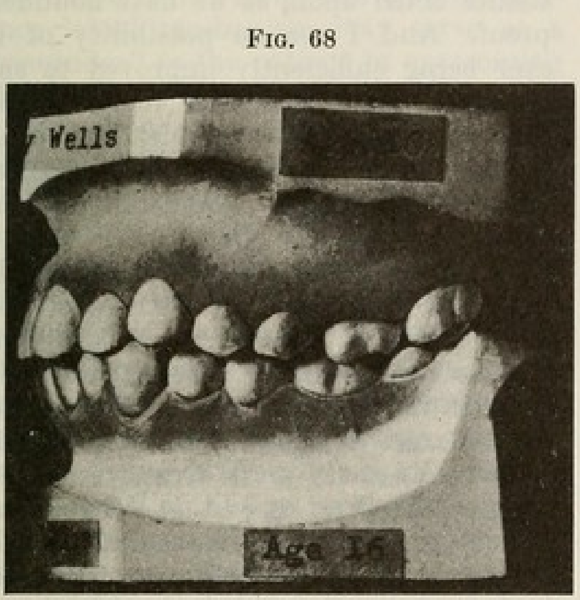


Fig. 67



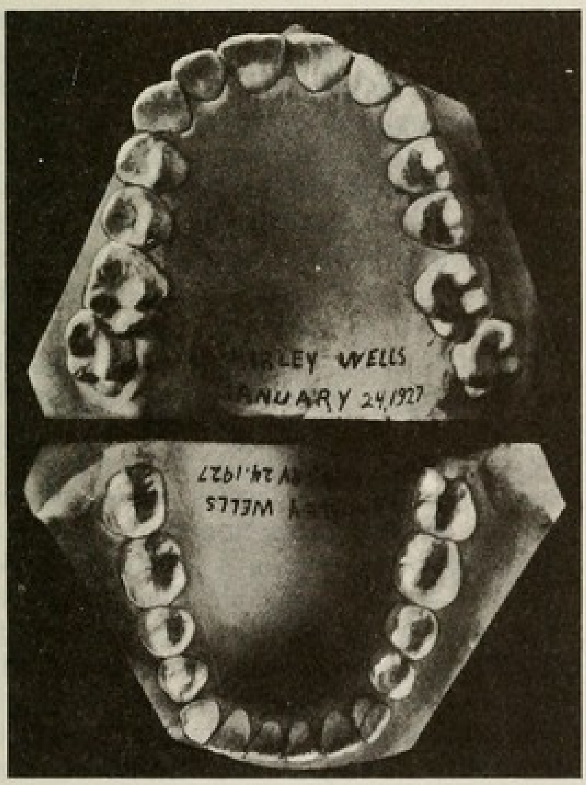
truthfully indicated by the positions and inclinations of the cuspids.

FIG. 68



The correction of all of these malpositions certainly offers an extreme test to any orthodontist and to any orthodontic

FIG. 69



mechanism. Yet you cannot fail to observe, in Figs. 68 and 69, how fully all of the teeth are shown to have been placed in their correct relations in the dental arches and in their correct positions of interdigitation through movements of the first order, and into their correct axial relations and relations to the skull through pronounced movements of the second order; in other words, the teeth have been placed in their *normal positions in the line of occlusion.* In this case the torque power was also enlisted on some of the incisors, but only as an auxiliary to anchorage.

FIG. 70

The facial lines of the patient after treatment are shown in Fig. 70.

It would seem that the impossible had been accomplished in this case, and that in the short period of eight months. The case was treated by Dr. Allan G. Brodie.

This result, although beautiful now, will be very much better after the teeth have settled into place and the natural development of the alveolar process and related tissues has taken place, as in that historical case, the Huning case, well known to you all. (See pages 340 to 348, seventh edition).

The students who have done this work have all emphatically expressed the belief that they could considerably reduce the period of treatment in each of the several cases could they but repeat it. I wonder how many times the same thought has been echoed in the mind of each of us in our own experiences.

Of course I could show you many more cases treated in the clinic by these and other students by means of this mechanism exclusively, but as the patients are waiting, the students will all take pleasure in showing you their work, and you will have abundance of opportunity to question them, after which you will also have opportunity for the full and free discussion of the various points in this paper.

Now, in common with all new orthodontic mechanism, the one I have shown you today must and should be brought into sharp comparison now, at the time of its introduction, with that which is already employed, before it can with full confidence be adopted. We can therefore, to advantage, spend a few moments in analyzing for the sake of comparison with it some of those mechanisms which, at the moment, seem to be popular.

First, the so-called "new" lingual arch mechanism, which some of us frequently see in the mouths of children who come over the mountains to spend their winters (or their summers, as the case may be) in our glorious "sun-kissed" Southern California, together with others from cities not so far away. In fact this mechanism is very familiar to us, as are also the all too many unfortunate results of its use.

You who have been taught to analyze orthodontic mechanism from the only truly scientific basis—that of dynamics, physiology and art—know that the possibilities of the correct treatment of the average case of malocclusion with this lingual mechanism are very small, and of difficult cases practically nil; that true force control in its use is greatly limited for any tooth movement and impossible for many because of the design of the mechanism, the principles upon which it operates, and its relation to the teeth dynamically and statically. Also, for these reasons, it violates the laws of physiology and not only permits but fosters jiggling of the teeth and interferes with the functions of the cells of the tissues acted upon, as we have abundant proof. And I see no possibility of its ever being sufficiently improved to successfully meet scientific demands for force control. For example, how could it possibly be operated to accomplish, with physiological rapidity, difficult movements of the first order, such as rotation of cuspids and bicuspids, depression of teeth, root-movements, etc., or to perform the movements necessary for the restoration of correct axial relations in the second order of movements, or to exert torque force in the third order? Even its most ardent advocates have reported no cases that I have been able to find in which movements of the second and third orders have been proved to have been accomplished with it, yet most certainly their practices must include cases in which such movements are required.

I leave you to judge as to the probable length of time that would be necessary to accomplish with the lingual mechanism the extensive movements that are shown to have been successfully accomplished in the cases I have just illustrated and that you will see in many other cases that are later to be reported.

One unfortunate feature of the lingual type of mechanism far too little considered, is that it occupies a most irrational position in the mouth and thus greatly restricts the operation of mechanics and interferes with the important functions of the tongue. Another very disagreeable feature of its wearing is its tendency, by no means infrequent, to become embedded in the soft tissues, when inflammation of the gums, sometimes serious, is provoked, as we have all noted. Also it is more than probable that the establishment of unfortunate tongue habits frequently results from its inordinately long-continued wearing, in all of which particulars this mechanism contrasts most unfavorably with labial mechanism correctly designed, constructed, adjusted and operated, the logical position of which in the mouth offers opportunity for the freest control of force, with no interference with the gums and very little with the cheeks or lips, when properly employed. Furthermore, by its presence labial mechanism may serve as a "reminder" to the patient in overcoming abnormal lip habits.

The chief excuse offered for the employment of lingual mechanism is that "it doesn't show," and therefore conforms more closely to the requirements of art than does labial mechanism. But, all things considered, does it? In its use is magnified by far the least important of the three basic essentials of an orthodontic appliance, the two of tremendous importance, that is, physiology and dynamics, being practically set at naught.

If correct in design, proportions, construction, application and operation and kept clean and bright by the patient (and there is no excuse for its not being so kept), a labial appliance will not be unpleasing in appearance and I have heard remarkably few objections to the wearing of the new or any other proper labial mechanism. On the contrary, the patients can readily understand its operation and usually take the keenest interest in the changes in the positions of their teeth which they daily note.

The lingual arch mechanism is constructed on very old and very weak principles and why, at this day and stage of advancement of the science, orthodontists would even consider its use is incomprehensible.

As to the so-called orthodontic appliances of the crib variety as a means for controlling force for the movement of teeth, their possibilities greatly exceed those of the lingual arch mechanism just considered. But their necessary frequent removal and replacement by the patient so disturbs the alveolar tissues and so violates the laws of physiology that this alone should be enough, today, to condemn it, to say nothing of the impossibility of accomplishing with it the prompt, successful uprighting of teeth, root movements, rotation, torque movements, etc. Yet it possesses one important advantage over the mechanism last considered, and one that should not be overlooked. This is that when it tends to become embedded in the gum and otherwise burdensome, the patient can and often does remove it and thereafter wears it in his pocket.

In conclusion, I hope you may be successful in the use of the new mechanism, and I know you will be just in proportion to the energy and enthusiasm you put into its study and use. In the application and operation of the mechanism there are, of course, many more points of interest that I might dwell upon, but they are only such as you, with your experience, judgment and skill in orthodontic practice, will naturally and readily work out for yourselves, and apply as occasions present in your daily practices.

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