and attempts to get a uniform heating by holding it longer in the flame. This results in the overheating of the pellet at the end most remote from the pliers, and the fusing together of the layers of foil at that point so as to present a harsh, unyielding mass, with which it is impossible to do uniform work. If an operator must employ the flame for annealing he would better use the smallest pliers obtainable, and grasp the minute corner of one end of the pellet and pass it carefully through the flame, or near the flame, till the other end reddens. Then, dropping the pellet in the gold drawer, he should pick it up again at the annealed end and gently heat the other one. In this way both ends are annealed; but even then there is a lack of uniformity in such a method, and it also requires unnecessary time and undue manipulation of the pellet before it reaches the cavity. A pellet should be handled as little as need be from the time it leaves the gold-beater till it is placed in position in the tooth.

Another method employed by some operators to obviate the difficulties just indicated is to roll their foil into a rope of suitable size, and then anneal the entire rope, cutting it into pellets subsequently. An objection to this is found in the fact that with a rope of annealed gold the impact of the scissors in cutting the pellets compresses the rope so that there is a line of condensed gold across each end of each pellet before it is placed in the cavity. This may appear a trivial consideration, and yet it is attention to the minutiae which goes to make up the most perfect result in the insertion of gold. A pellet condensed at either end in this way is not so obedient to the plugger, nor can it be so accurately manipulated in the performance of delicate work as can a uniform pellet.

The plan of some operators whereby the plugger-point is used to pick the gold from the drawer and carry it to the flame and then to the cavity, is objectionable in several particulars. Unless the point is heated sufficiently to ruin its quality as a plugger, the gold is never perfectly annealed in the region of the point. If it is annealed at all adequately, the point is made so hot as to be painful to the patient on application to the tooth, and the products of repeated oxidation at the end of the point are continually being incorporated into the structure of the filling, which, at best, cannot result to its benefit. There is also a lack of uniformity in the degree of annealing throughout the pellet, the ends being invariably heated higher than the part touched by the plugger-point. The same condition exists, though in a modified degree, when a smaller instrument is used for picking up the gold in lieu of a plugger, as practiced by some operators. Another minor objection relates to the fact that when a pellet is annealed in this way it has a tendency to slightly change its form under the flame, so as to drop from the plugger or annealing instrument and fall into the flame.

In view of these considerations, it would seem desirable for the profession to adopt a different method of annealing gold to obtain the best results. The problem to be solved is simply to heat the gold sufficiently to effectively drive off all gases from its surface.
without the possibility of concurrent contamination, and with absolute uniformity of annealing throughout the mass. Various methods have been devised for this purpose, the one most employed in the past being to place the gold on a mica or metal tray over the spirit lamp, and allow the heat thus generated to gradually accomplish the purpose; but the most perfect method yet suggested is through the medium of the electric gold annealer devised by Dr. L. E. Custer, of Dayton, Ohio. With this appliance complete uniformity of result is obtained in the most convenient and ready manner, and with no liability of contamination. Even to operators who have been accomplishing apparently satisfactory results by other means, this appliance will soon reveal a working quality to the gold which seems impossible of attainment in any other way, and it is confidently believed that its general adoption by the profession would disarm much of the criticism which is occasionally waged against the manufacturers of gold on the plea of lack of uniformity in preparation. The only procedure necessary is to place the pellets in convenient arrangement on the annealer and turn on the current, which may be left running to the end of the operation. No matter how long the current is on, there is no overheating of the gold. It simply anneals perfectly, without ever fusing any of the layers of the pellets together.

A most satisfactory manner of treating gold from the time it reaches our hands till it is carried to the tooth is to first subject it to the influence of ammonia gas by placing in a small porcelain receptacle a pledget of cotton saturated with aqua ammonia, and setting this in the same drawer with the gold, leaving the box or bottle containing the pellets open, so that the gas may readily act upon them. The pellets are thus rendered uniformly soft, velvety, and manageable. They are absolutely non-cohesive. They may be shaken or rubbed together ad libitum without one pellet, even in the slightest degree, adhering to another. When the filling is to be made they should be transferred to the annealer and the current turned on, the result of which will furnish a series of pellets each in its behavior precisely like its fellow. Gold treated in this way has a beautifully soft working quality, devoid of harshness, but capable of perfect cohesion and density under the impact of the plugger.

With gold prepared according to these details, and with the characteristics of its manipulation perfectly understood, it is nearly or quite as easy of introduction into a cavity as any of the other filling-materials, the chief distinction being the greater length of time necessary to insert it. It must be built up piece by piece, while most of the other materials may be added in masses of greater bulk.

For those practitioners who are not convenient to the electric current it is suggested to employ gas for this purpose, by arranging a series of small jets on the same principle as the modern gas cooking burners, whereby the heat may be distributed as uniformly as possible upon a given area, and placing over this a framework supporting a piece of mica or other suitable material to prevent
contact of the gold with the flame. On this the gold may be satisfactorily annealed, though not so rapidly nor so perfectly, so far as the regulation of heat is concerned, as by the electric appliance. In case gas is not available the same arrangement may be made with a spirit lamp, but this is slower in its results, and the heat is less readily distributed with uniformity throughout the surface of the annealer.

It would seem that either of these methods was greatly to be preferred to the one so common in vogue of passing the gold through the-flame, and a careful consideration of this entire subject of the proper preparation of our gold for filling teeth is hereby strongly commended to the profession. Gold has almost invariably been credited with the advantage of having claimed a more serious study in its management and a greater care in its manipulation than any other filling-material we possess, and yet in this one particular it would sometimes appear as if it had been strangely misunderstood in its characteristics or ignored in its chief requirements.

**Different Forms of Gold.**

The form in which gold is used in filling teeth is largely one of individual preference, whether in ropes, pellets, cylinders, or strips. Possibly the best results are obtained by a convenient arrangement of the different forms in the same cavity, such, for instance, as starting the filling with a rope of non-cohesive gold of suitable size and building the main body of the filling with pellets or cylinders annealed, followed by strips of heavy gold upon the surface. Some operators are in the habit of twisting their foil into ropes, and cutting these into pellets for general use. Others, whose methods of operating are highly individualized, cut the foil into strips and roll these into cylinders of varying sizes for the special case in hand. One advantage of this method is that the layers of foil constituting the cylinder are arranged in a regular series, one upon the other, and are therefore capable of a more even placement in the filling than when the pellets are cut from a twisted rope. This even arrangement of the layers of foil in building a filling is an item of some importance in its relation to the strength of the filling and its uniform density, but the element of time in the preparation of these cylinders must also be acknowledged as a consideration with the busy practitioner. The prepared pellets or cylinders of graded sizes and lengths, as they come to us from the manufacturers, would seem to furnish a most convenient form for the bulk of our work, and these, supplemented on the surface in cases calling for special density with strips cut from Nos. 30, 60, or 120 rolled gold, are capable of producing a uniformly good result. For the rapid-acting mallet, in cases where it may not seem desirable to use the heavier foils, strips can be prepared by folding the lighter foils and cutting them into suitable widths. For instance, a sheet of No. 4 foil may be folded three times, which makes four layers of foil. This fold is then cut into strips of from two to three millimeters in width, making a very convenient preparation for the rapid mallet.
The form of the different kinds of gold will receive more detailed mention incidentally with the consideration of their introduction into the various classes of cavities.

Crystal Golds.

Crystal gold is prepared by precipitating the gold into crystals instead of by beating it into foil. Its working qualities are somewhat different from foil, and its characteristics must be well understood in order to obtain good results. Some operators seem to have a peculiar aptitude for manipulating this kind of gold, and are able to use it more satisfactorily than foil, but for the great majority of practitioners it can never be relied upon to do the same service as foil in the varying conditions presented in different classes of cavities. Its main virtue lies in its tendency to remain placed in the bottom of a cavity when once forced there. It does not so readily curl away from a wall, or rock under subsequent pressure, as does foil, and it is therefore indicated for starting the filling in those cases where the best retentive form to the cavity at this point has not seemed possible of attainment. It is also more rapidly condensed in a cavity, the filling apparently growing in bulk at a greater rate of speed under the plugger than where foil is used; but this very rapidity of growth may prove an element of insecurity in the constant danger of bridging over spaces and leaving a filling imperfect in density. This may readily occur with a careless operator, while the surface of the filling appears satisfactory. The fact that large masses of crystal gold may be inserted into a cavity and matted down to place with apparent ease is calculated to mislead many operators. These large masses behave much like wet snow under pressure,—they condense on the surface but are inclined to remain porous in the depth of the mass. In order to accomplish good results with crystal gold, and do justice to the material, the very greatest care must be used in its manipulation. It will not tolerate the range of usage that will foil, and unless an operator is prepared to give a careful study to its peculiar requirements he would better not employ it. The chief distinction in this connection between foil and crystal gold is that foil demands care, and so expresses itself at every turn, while the other demands equal or greater care, but seems to constantly give the impression that it does not.

As to the form of crystal gold best adapted for serviceable work, those preparations in which the deposit has been carried on long enough at one time to produce crystals or spiculae of considerable length would seem to offer the greatest promise of usefulness, both as to strength of the finished product and convenience of manipulation. A mat of gold formed of small crystals is granular in structure. It is easily disintegrated in handling, and crumbles so as to waste extensively; while a filling made from it cannot be expected to present the same strength in a given mass that would one made from gold of a more fibrous nature. Another important consideration in this connection is that a fibrous gold may be expected to result in better margins to the filling than one of a granular struc-
ture. One serious limitation to some of the crystal golds offered in the past has been the insecurity of the material when built over beveled enamel-margins, on account of the tendency to disintegrate and crumble away. The more perfectly the fibrous arrangement is maintained, the greater strength may be expected of the material. Recent improvements along this line in the manufacture of crystal golds would seem to promise an increased usefulness for them in practice, but, as already intimated, no operator should employ them without a perfect understanding of their peculiarities.

The main points to be considered in manipulating crystal gold relate to accuracy in placing each pellet as it is carried to the cavity, to a careful selection of the cases suitable for its use, and to the proper form of plugger-points. Each piece of gold should be carried precisely to the spot where it is intended to condense it, and it should not be disturbed by too much manipulation before it is condensed. It is quite impossible, with crystal gold of good cohesive texture, to move a pellet of it across the surface of the gold already in the cavity for the purpose of securing a more convenient position. Any attempt to insinuate it out of the location first taken will result in tearing the uncondensed pellet so that it is disintegrated and wasted.

The places where crystal gold is indicated are in starting fillings in difficult cases, and in large, open cavities easy of access, where the gold may be conveniently laid on in regular arrangement and condensed under the eye of the operator. It should not be employed for filling undercuts or remote positions in cavities, on account of the tendency to bridge.

The pluggers best adapted to its use are the oval-faced forms, with shallow serrations. For starting the filling a large point should be used, with vigorous hand-pressure, to carry the mass in front of the plugger instead of puncturing it; but as the filling is being built up too large points must not be used, for fear of failure in density. A convenient method of condensing the main portion of the filling and securing an even surface is to use a rapid mallet with the Royce plugger-points. These points, being oval on their serrated ends, may be swept back and forth across the surface of the filling with little danger of tearing the uncondensed gold away and wasting it, as is sometimes the result with flat-faced pluggers. The Royce pluggers should be held a short distance from the condensed surface, so that the jump of the mallet catches the gold in front of the plugger and mats it to place.

(To be continued.)

DOUBLE RESECTION OF THE INFERIOR MAXILLA FOR PROTRUDING LOWER JAW.

BY JAMES W. WHIPPLE, D.D.S., ST. LOUIS, MO.

A year has now elapsed since the operation of double resection of the lower maxilla was performed for Mr. W. G. K. by myself and surgical associates.
I take great pleasure in further reporting that the operation has proved to be entirely successful in every respect, the result being all that could be desired and more than was hoped for.

The profile and contour of the patient's face and features are very nearly perfect, and the scars can scarcely be noticed by a casual observer. The jaw is strong and firm, and mastication is perfectly done in a normal manner.

He still feels a sense of hesitation about biting very hard substances, just as one hesitates about putting his entire weight on a limb that has been broken, walking with a "limp" long after he is perfectly well. The pulps of his teeth are all alive, and his gums are firm and healthy.

His teeth all occlude properly, each one coming in contact with its proper antagonist. The entire loss of sensation in the lower lip continues. I used his own words, however, in my report when I said that this was regarded as a matter of "inconsiderable importance." There is no sense of loss or physical incompleteness connected with it.

In short, he is entirely well, and moves among his fellows happy in the consciousness that no semi-deformity longer mars his personal appearance or distinguishes him from his formerly more fortunate companions. I regret that, being a very modest young man, he declines to permit me to use his photograph in connection with this article.

My attention has been called to an article by Dr. Eugene S. Talbot, of Chicago, in the International Dental Journal for October, 1898.

This article contains a wholly unwarranted assumption, and an entirely unnecessary mistake. I am inclined to believe that Dr. Talbot is gifted with a pair of Sam Weller's famous "patent double million power magnifyin' gas microscopes" instead of the usual visual equipment of ordinary men. The upper jaw of W. G. K. is fairly well developed, the retraction being so slight as to be imperceptible to any except a close observer.

The deformity in his case was caused, as I stated in my plain report of the case in the July (1898) DENTAL COSMOS, by an abnormal growth or development of the lower jaw.

A younger brother of W. G. K. is now undergoing an identical process of malformation, his lower jaw having grown forward more than one-eighth of an inch during the current year. I am observing this curious and extraordinary facial transformation with the deepest interest, and hope in due time to give Dr. Talbot an opportunity to distinguish himself by performing his truly wonderful operation for correcting protrusion of the lower jaw by operating on the upper. The young gentleman may not be a very nice-looking man when Dr. Talbot is done with him, but would no doubt be regarded in the African forests as a remarkably handsome gorilla.

It is interesting to know that these young men inherit this malformation from their grandfather on the maternal side, who was the unfortunate possessor of a similar deformity.
Dr. Talbot says, “Dr. Whipple was still trying to adjust an appliance to hold the parts together on the 26th of the following April.”

Dr. Whipple was “trying” to do nothing of the sort. From April 26 to May 4 I adjusted six gold cap-crowns to “correct the occlusion of the teeth.” I would hardly have done this on a jaw that needed an appliance to “hold it together.” Let me recapitulate. Operation done on December 19, 1897. Patient brought to my office January 10, 1898. Strong osseous union found on February 14. By March 5 all appliances had been removed, and since that time the jaw has had no support of any kind save from the reunited bone.

That I have been so fortunate as to be able to bring about such an entirely successful result in this case is, considering the condition of the patient when brought to my office on January 10, a matter of surprise as well as of gratification to me. Nothing but loyalty to my friend induced me to undertake the work. If the net result of my work has been to “increase the deformity and further humiliate the patient” (vide Dr. Talbot’s article), I am at a loss to understand why my friend so willingly and gratefully paid me a very handsome fee for my part in the operation. I do not see any reason for the serious doubts entertained by Dr. Talbot as to the continued vitality of the “eight anterior teeth.”

Many cases of excision of the inferior dental nerve are recorded in the annals of surgery, and I am not aware of the pulps of the anterior teeth having been recorded as affected by this operation, at least to the extent of the loss of their vitality.

Dr. Edward H. Angle (DENTAL COSMOS, August, 1898) is, I think, too severe in his criticism of the surgeons in this case. They are men of high standing and undoubted skill. But little can justly be said in adverse criticism of the strictly surgical part of their work. However, these gentlemen are amply able to defend themselves. The great mistake made was in neglecting to have the appliance made according to the instructions given W. G. K. by the writer. This was to have been made exactly in the manner described by Dr. Angle in his article. Great was my surprise when I reached the operating room to find the operation in progress without any appliance of any kind having been prepared. Feeling certain that the operation would be a failure, and being entirely unable at that late hour to be of any help to my unconscious friend, I quietly withdrew from the operating room and the case. When the patient again came under my care and authority I proceeded in the manner described in my report, and which I most emphatically insist was the only proper manner at that stage of the case. This is fully proven by the perfect success attained. There was absolutely nothing either “crude, unstable, or unscientific” about my work, and I am quite sure no more perfect result will ever be secured under similar conditions.

It matters but little what Drs. Allport, Brainard, Moses Gunn, and Powell may have thought about this operation, or, for that matter, what Socrates, Solomon, or Moses may have thought about
it in their day. The cold fact remains that it has been successfully done, and that settles its standing as a proper surgical procedure.

It may be of interest to modern Don Quixotes to know that a somewhat similar operation was performed more than fifty years ago by Dr. S. P. Hullihen, of Wheeling, Va. (now West Virginia), and that a full and very elaborate account of it may be found in the *American Journal of Dental Science*, January, 1849.*

For my operation it can be justly claimed that it is the first case in which the operation has been done for an uninjured person and solely for cosmetic purposes.

Practical experience in this case has led me to believe that the appliance described by Dr. Angle, and which I originally intended using, is not the proper form of appliance to use. Its lack of adjustability is its worst defect. It would be difficult to make one that would fit the natural teeth after the operation without causing some displacement of the sections at the inferior border, and without interfering with a perfect approximation of the opposing ends. It must not be forgotten that union of the bone may not be secured on one or both sides, in which case the appliance would have to be removed and readjusted. This would be an exceedingly difficult and annoying thing to do with this form of splint.

A continuous cap splint may do very well in cases of ordinary fractures of the lower jaw-bone where the line of breakage runs obliquely across the bone, with irregular and jagged surfaces which aid in holding the parts in position. But the smooth, plane surfaces of a resection operation present many different and difficult problems to evolve, and require very different treatment.

A professional orthodontist may probably be pardoned for attaching undue importance to the occlusion of the teeth. This, however, is, in fact, a matter of minor importance which can be corrected by adjusting gold cap-crowns, and it is immaterial whether two or more such crowns are used or whether they are a little longer or shorter. The prime consideration is a proper approximation of opposing ends of the bone sections, so as to promote a rapid and perfect reunion of all the parts, especially at the inferior border, where they should present a smooth and even continuous surface. The dense bone of the inferior border and the external and internal surfaces must be placed in direct apposition, regardless of the occlusion of the teeth. This can only be safely done by using a wire ligature at the base of the bone; and this should, in my opinion, be regarded as absolutely necessary, otherwise some displacement will surely occur. I will now describe the manner in which my experience and observation have led me to believe this operation should be performed.

In the first place, it should be regarded as a purely dental operation. The surgical part is simple and unimportant, and can readily be done by any surgeon or dentist of average skill.

Models should be made of both jaws, that of the lower jaw approximating the natural bone in size and shape, and which

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*I am indebted to Dr. E. C. Kirk, editor of the *Dental Cosmos*, for this interesting information.
should be attached to the main body of the articulated models by small brass hinges, set vertically, so as to allow of lateral motion. Two lines should now be made on the external surface of the lower model, at the point to be operated upon, exactly one inch apart. A small section should now be removed on each side, between the lines drawn. It will be found that the cusps of the molars will interfere when the posterior sections are moved inwardly. These cusps should be cut down until they clear the opposing teeth, and the natural organs are to be ground off to a corresponding degree. The ends of the plaster sections are now trimmed away, until all the parts are brought to a supposedly proper position. I doubt the desirability and the feasibility of making V-shaped sections, though this feature should receive due attention if indicated by the curve of the jaw.

When the sections are waxed or cemented together the distance between the lines should be carefully measured at both borders, and by subtracting these measurements from the original distance of one inch the exact size and shape of the section to be removed can be accurately determined. An adjustable double bone saw having been procured, the same should be so adjusted as to remove a section of the desired width. An Angle molar band should now be fitted to one of the plaster molar teeth, being careful that the screw and nut point in a posterior direction, so as not to encroach upon the space to be operated upon. A similar band should be adjusted to the cuspid or bicuspid tooth, the screw and nut being directed anteriorly. A line should now be marked, using a straight edge of some kind, across both bands, giving the proper angle and direction for the tubes. A gold thread-cut tube is now soldered on the molar band, and an ordinary tube on the bicuspid band. These tubes must not extend over the space to be operated upon, it being intended that all these bands and tubes shall be adjusted to the natural teeth before the jaw is operated upon. A traction bar or screw of the proper length, with a flanged shoulder and a square end, should be made. This is slipped through the bicuspid band tube and screwed into the entire length of the thread-cut molar tube, which it should fit perfectly. A long-handled key, like an old-style watch key, made to fit the square end of the traction bar, should be used for this purpose. An appliance of the same kind is to be made for the opposite side of the jaw. An appliance of this kind can be tightened or loosened at will, at any time that it may be necessary during the treatment of the case, without pain to the patient or trouble to the operator. If any accident or breakage of its parts should unfortunately occur, it can be easily removed and replaced.

Before beginning the surgical work, all of those bands are to be adjusted to the several teeth selected for the purpose. The position of the patient and the flow of blood would make this a very troublesome thing to do if deferred until the surgical operation is completed. All being in readiness, the external incisions are made and the sections sawed almost through. Small holes are now drilled in the end of each of the large sections, near the base line.
The small sections are now entirely removed. A rather stiff copper wire ligature is passed through the holes from the external surface and tightly twisted, thus bringing the ends of the sections firmly and smoothly together at the inferior border. The traction bars are now placed in the tubes, traction applied with the key-wrench, and in a few minutes all the various parts form a firmly fixed and practically immovable whole. A small piece of wood, four inches long, one-half inch wide, and three-eighths of an inch thick, is now placed between the oral teeth. Two rolls of gutta-percha base-plate, one inch long and one-half inch in diameter, are softened in hot water and placed between the teeth on each side of the piece of wood. The jaws are now gently pressed together and the gutta-percha allowed to harden. The wood is now removed, leaving a space through which nourishment can be given the patient. A four-tailed plaster bandage is now applied, and the operation is ended. The wounds at the points of incision are to be dressed every other day. The mouth should be carefully washed once or twice a day with listerine. No wash containing formaldehyde should be used, as it will cause sloughing of the gums and a peculiarly annoying soreness of the teeth in the anterior section.

Fellows's syrup of the hypophosphites should be administered. In from twenty-one to twenty-eight days the bone should be strongly knit together, since of all bones the lower maxilla reunites the most rapidly. Within six weeks the patient ought to effect a full recovery, happily forever free from the distressing deformity that has made life full of unhappiness and humiliation.

One assumes a serious and solemn responsibility in entering upon the performance of such an operation on a healthy and otherwise perfect jaw, but I believe the ends attained fully justify it in all these cases of pronounced deformity. I can see no reason for regarding it as a dangerous operation. Done under strict and proper aseptic conditions, the chances of a failure are very remote. There is, of course, a possibility of blood-poisoning, but this is an ever-present danger in all operations, even the simplest. The extraction of a tooth or the opening of an abscess may cause death, but that remote possibility does not prevent the most cautious of men from doing these things.

Double resection is a perfectly legitimate and safe operation, and I believe that it should and will become a merely ordinary one in course of time. In the case of W. G. K., fortunately for the future of the operation, every probable difficulty and danger were met and successfully combatted. This fact should greatly encourage the timid and give boldness to the daring in the performance of an operation which has such possibilities for the relief of suffering and the restoration to symmetry of the human face divine.
THE DENTAL COSMOS.

CLASSIFICATION OF MALOCCLUSION.*

BY EDWARD H. ANGLE, D.D.S., ST. LOUIS, MO.

The term "irregularities of the teeth," as it is usually applied to express teeth that are twisted or unevenly arranged, does not, in the author's opinion, properly express the full meaning of these deformities. It would seem that the term malocclusion would be far more expressive; for in studying the subject we must not lose sight of the importance of the dental apparatus as a whole and the important relations not only of the two arches to each other, but of the individual teeth to one another. The shapes of the cusps, crowns, roots, and the very structure are all designed for the purpose of making occlusion the one grand object, in order that they may best serve the purpose for which they were designed,—namely, the cutting and grinding of the food. Examined carefully, it will be seen that there can be no "irregularities" of the teeth if they are in perfect occlusion, but that all must be regular and even, each contributing to the support of the others, and all in perfect harmony. Not only this, but the jaws, the muscles of mastication, the lips, and even the facial lines, probably, will be in best harmony with the peculiar facial type of the individual.

Therefore, it would seem that the term malocclusion of any tooth or number of teeth would not only better express the true condition, but naturally and constantly suggest the paramount importance of occlusion in the study and treatment of these deformities, instead of making it secondary or even losing sight of it entirely, as has been too much the case in the past. The author has become firmly convinced that occlusion is the very basis of the science, and that in the treatment of cases, unless occlusion is established, the results will be largely of the nature of failures. So in the pages that are to follow we shall make occlusion the central thought, and on it base the classification of "irregularities" as well as the nomenclature; and will define orthodontia as being that science which has for its object the correction of malocclusion of the teeth.

DIAGNOSIS OF CASES.

In every case of malocclusion of the teeth presented for treatment the importance of a correct diagnosis of the true conditions, and the requirements, cannot be overestimated. Otherwise any plan of treatment will be very uncertain as to results; in fact, most apt to lead to failure with all of its embarrassments.

From an extensive intercourse with dentists and students I am impressed with the belief that although diagnosis is the question of greatest importance, it is yet apparently the least intelligently studied and comprehended.

In the beginning, I wish to thoroughly impress the necessity for complete separation of diagnosis from treatment. This statement seems necessary for the reason that I have so frequently noted a mental conflict in the endeavor to consider the two together in the

*From a forthcoming book by the author.
first instance, the question of treatment by appliances or by extraction apparently forcing itself into the first view before the facts upon which these should be based have had due consideration. As a matter of fact, if the diagnosis of any given case is first thoroughly mastered the line of treatment and the appliances necessary to bring about the various tooth-movements required are, in nearly every instance, clearly indicated, even to the devices necessary for retaining the teeth when correctly placed.

In order to diagnose all cases of malocclusion correctly it is necessary to be familiar with, first, the normal or ideal occlusion of the teeth; second, the normal facial lines. These must be so fixed in the mind as to form the basis from which to reason, and to intelligently note all deviations from the normal; and it must follow that without clear, fixed, and definite ideas as to the normal, the limits or boundary lines of the abnormal must also be vague and indefinite, and the line of treatment the merest empiricism.

A knowledge of the occlusion of the teeth being of the first importance, should embrace a knowledge of not only the normal relations of the occlusal surfaces of both permanent and deciduous teeth, but of their entire forms and structures. The growth and normal development of the jaws and muscles, together with the development of the teeth and the normal periods for taking their positions in the arches, should receive careful attention. Our perceptions of the subject would be broadened also by a comparative study of the occlusion of the teeth of the lower animals.

Normal Occlusion.

This knowledge is the basis of the science and the most important lesson to the student of orthodontia. The limits of this work will, however, permit of the consideration of only the most important of its many phases.

By referring to Figs. 1 and 2, which represent the teeth in the ideal occlusion, it will be seen that each dental arch describes a graceful curve, and that the teeth in these arches are so arranged as to be in the greatest harmony with their fellows in the same arch, as well as with those in the opposite.

The lower arch is somewhat smaller than the upper, so that in occlusion the labial and buccal surfaces of the teeth of the upper jaw slightly overhang those of the lower. The key to occlusion is the relative position of the first molars. In normal occlusion the mesio-buccal cusp of the upper first molar is received in the sulcus between the mesial and distal buccal cusps of the lower, the slight overhanging of the upper teeth bringing the buccal cusps of the bicuspid and molars of the lower jaw into the mesio-distal sulci of their antagonists, while the upper centrals, laterals, and cuspids overlap the lower about one-third the length of their crowns. The upper central being broader than the lower, necessarily extends beyond it distally, overlapping, in addition, about one-half of the lower lateral; the upper lateral occludes with the remaining portion of this tooth, and with the mesial incline of the lower cuspid, the mesial incline of the upper cuspid occluding with the distal incline.
of the lower; the distal incline of the upper cuspid occludes with the mesial incline of the buccal cusps of the lower first bicuspid; the mesial incline of the buccal cusps of the upper first bicuspid occludes with the distal incline of the buccal cusps of the lower first bicuspid.

FIG. 1.

This order is continued through the bicuspids. The mesial and distal inclines of the mesio-buccal cusps of the upper first molar are received between the mesial and distal buccal cusps of the lower first molar, and the inclines of the disto-buccal cusp are received.
between the disto-buccal cusp of the first lower and the mesio-buccal cusp of the second lower. This same order is continued with the second and third molars, the distal incline of the disto-buccal cusp of the upper third molar having no occlusion. It will thus be seen that each of the teeth in both jaws has two antagonists or supports in the opposite jaw, except the lower centrals and the upper third molars.

As the inclined planes match and harmonize most perfectly in the bucco-occlusal relations of the teeth, so there is a similar arrangement in the linguo-occlusal relations, except that the lower bicuspids and molars project beyond the upper into the oral space; likewise in the transverse arrangement, the buccal cusps of the lower molars and bicuspids pass between the buccal and lingual cusps of the upper molars and bicuspids, and the lingual cusps of the upper molars and bicuspids between the buccal and lingual cusps of the lower molars and bicuspids. The grinding surfaces are thus enormously increased in extent and efficiency over what would be possible if they consisted of a single row of cusps or of plane surfaces. But increase of masticating surface is not the only, perhaps not the most important, reason for this complex interdigation of the cusps and inclined planes of the teeth. A very important office of the interdigitating cusps and planes is the part they play in the mutual support of the teeth. The sizes, forms, interdigitating surfaces, and positions of the teeth in the arches are such as to give to one another, singly and collectively, the greatest possible support in all directions.

Another important part played by the inclined planes of the cusps is in influencing the directions of the teeth while erupting and taking their positions in the arches. If, however, their influence is perverted, they may become mischievous factors in the production of malocclusion. When the teeth first emerge from the gums considerable displacement is often noticeable, but this need occasion no uneasiness, provided, as eruption progresses, their cusps pass into the normal influence of the inclined planes of the opposing cusps; but once passed beyond the normal influence into the abnormal they will not only be deflected from their proper relations in the arch, but will assist in the displacement of the opposing teeth, as well, oftentimes, as of those which are to follow in eruption.

So the dividing line between harmony and inharmony of occlusion is often very slight. Hence the importance of careful attention during the important period covering the eruption of the permanent teeth.

The Forces which Control Occlusion.

Harmony between the upper and lower arches and their teeth is also powerfully promoted by their normal action and reaction upon each other. As the teeth of the lower arch erupt before those of the upper, and are consequently to an extent fixed in their positions before their antagonists appear, it follows that the lower arch is the form over which the upper is molded. In other words, the
lower arch exerts a controlling influence over the form of the upper and the positions of the teeth therein. Of course, the upper reacts upon the lower, but it is unquestionable, in the author’s opinion, that the lower arch is the more important factor, not the upper, as has hitherto been taught.

It will thus be readily seen how greatly one arch contributes to the other in maintaining its form and size so that pressure, as, for example, on the labial surfaces of the upper incisors, would be resisted not only by all the upper teeth acting as keystones in an arch of masonry, but also by the teeth of the lower arch acting through occlusion.

Inversely, then, one arch cannot be altered in shape without modifying that of the other, nor can it be altered in size without soon exercising a marked effect upon the other.

This important fact is of the greatest interest to us as students of orthodontia,—namely, that in a case of perfect occlusion, as in the illustrative case shown, each tooth is not only in perfect harmony with every other, but helps to maintain it in its harmonious relations; for the cusps interlock and each sloping plane serves not only keep the tooth in position, to prevent it from sliding out, but to wedge it into position if slightly malposed; that is, if not beyond the normal influence of the inclined plane.

A careful study of the relations of the inclined planes and the marginal, triangular, transverse, and oblique ridges, in connection with the movements of the jaw, cannot fail to impress thoughtful persons with the wonderful efficiency of the human teeth for incising and triturating the food required by man, and with the marvelous arrangement for self-cleansing and consequent self-preservation which they display.

The harmonious relations of the occlusal planes and of the dental arches are further assisted by another force,—namely, muscular pressure, the tongue acting upon the inside and the lips and cheeks upon the outside of the arches. The latter serve to keep the arches from spreading, as do the hoops upon the staves of a cask; the former prevents too great encroachment upon the oral space. I am satisfied that this muscular pressure is a far more important factor in relation to the study and correction of malocclusion than is generally recognized. It not only contributes to maintaining the teeth in their normal positions and to harmony in the size of the normal arches, but it is equally powerful in maintaining inharmony in the sizes or relations of the arches and malocclusion of the teeth, when once established.

So it will be seen that the occlusion of the teeth is maintained, first, by the occlusal inclined planes of the cusps; second, by the support given by the interdependence of the arches due to their harmony in sizes when in normal relations; third, by the influence of the muscles labially, buccally, and lingually.

The illustrations show the result where these forces have acted normally,—a harmoniously aligned and occluded denture.

It should be borne in mind that these influences are none the less powerful in cases of malocclusion.